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DEVELOPMENT OF A MODEL WHICH DETERMINES A PERIODICAL WORK PLAN FOR A DEPOT

Shmuel Braun, Captain, I. A. F.
Ehud Tolidano, Captain, I. A. F.

LSSR 20-77B

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This thesis deals with recoverable inventory item management. The specific area addressed is the development of a model which determines the quantity to be recovered at the depot level in the next period and its essentiality.

The research consisted of two parts. The first part was the development of an efficient model to forecast the consumption of recoverable items during the next period, according to different categories of items. The second part dealt with the development of a recoverable inventory management model and its validation through computer simulation technique.

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DEVELOPMENT OF A MODEL WHICH DETERMINES A PERIODICAL WORK PLAN FOR A DEPOT

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

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September 1977

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This thesis, written by

Captain Shmuel Braun

and

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has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

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Donald R Edwards

COMMITTEE CHAIRMAN

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CHAPTER I

BACKGROUND

INTRODUCTION

The problem of accurately planning the accomplishment of defined objectives is extremely complex. Within the military environment, planning support activities to achieve specified combat readiness objectives is especially complicated. Such planning must be conducted subject to numerous constraints. These constraints restrict the alternative courses of action available to planners and frequently cause the cost of achieving stated objectives to be very high.

In Israel, this problem is compounded considerably by the imposition of two overriding constraints. These constraints are unique to the Israeli military forces and seriously limit the range of feasible alternatives to those in which cost minimization is not a prime consideration. The result is that optimal solutions tend to be very expensive. A planning process in which cost considerations are of only secondary importance would not be acceptable to nations that have less severe military constraints.

The first of these overriding constraints is imposed by the ever present threat of a military invasion of Israel by its neighboring countries. This threat makes it imperative that Israeli military forces are maintained at a high level of combat readiness at all times.

The second major constraint is a result of limited national resources. As a result of these resource limitations, Israel is forced to rely heavily on foreign suppliers of war materiel. This dependency on external sources of supply constitutes a serious constraint on defense planning. The significance of this constraint is heightened when one considers the impact foreign embargoes would have on the Israeli supply system. The possibility of embargoes is very real, as evidenced by the French embargo on military supplies that occurred in 1967, and the United States' "reassessment policy" that was implemented by the Ford administration in 1975.

This background information is presented to emphasize the fact that in many instances military preparedness planning is largely predetermined by a well-defined national policy that must be achieved subject to very binding constraints. Thus, the Israeli military planner's range of feasible alternatives is quite restricted.

GENERAL SCOPE AND JUSTIFICATION

Maintenance activities play a major role in the combat readiness posture of the Israeli Air Force. Without a strong maintenance

function, the effectiveness of the fighting forces would be greatly impaired. Within the Israeli Air Force, the maintenance function is divided into two well-defined subsystems. These two subsystems may be characterized by:

a. base level maintenance activities

b. depot level maintenance activities.

The two subsystems are interrelated through the Air Force Central Inventory Management System (CIMS).

The Central Inventory Management System is a computerized management information system that controls all the inventory activities that take place within the Air Force. Repairable items that cannot be repaired by base level maintenance are sent immediately to the central depot. The Central Inventory Management System determines the distribution of serviceable items from the central supply base to the various using organizations.

It should be emphasized that the I. A. F. supply system is a "push" system. In a "push" system, serviceable items are sent to using organizations according to criteria that are established by the item managers in response to total provisioning requirements. This system differs considerably from a "pull" system in which serviceable items are sent to using organizations only upon receipt of a request from the user.

Since the CIMS controls both base level and depot level maintenance activities, it contains a data base that provides researchers access to a vast amount of information. This study relies heavily on data extracted from the central inventory management system.

At the depot level, maintenance activities can be further broken down into three separate categories:

a. overhaul and repair of subsystems and items

b. overhaul and repair of main systems

c. overhaul and repair of aircraft

This research focuses on those activities that fall in the first category, overhaul and repair of subsystems and items in the depot.

STATEMENT OF THE PROBLEM

One factor that greatly influences the ability of the Israeli Air Force to achieve its desired preparedness posture is the existence of a satisfactory level of serviceable inventory. Maintaining a satisfactory inventory of serviceable items can be accomplished in two different ways:

a. through the procurement process

b. through the recovery of repairable items.

The dependency of Israel on external sources of supply, as well as budgetary considerations that restrict the quantities that can be

purchased, forces the Air Force to rely heavily on an efficient recovery system.

The capacity of the central maintenance depot is restricted by the limited availability of manpower, equipment and monetary resources. This limited capacity imposes a major constraint on planning for a recovery system.

The purpose of this research is to develop a mathematical model that can be embedded within an existing computerized management information system to provide depot level maintenance managers with periodic reports that specify:

a. The quantity of each item that must be recovered during the next period.

b. The priority, or relative essentiality, of each repairable item.

More specifically, this research is intended to provide a means whereby each depot department supervisor can be made aware of the quantity of each item to be recovered, as well as the priority that should be given each item. The priority of repair reflects the relative essentiality of the item when the total needs of the Air Force are considered.

BASIC ASSUMPTIONS

1. The proposed model requires as inputs only data that are available in the existing central inventory management system. It is assumed that the data are arranged in such a manner that it will be possible to extract required data elements in any stratified form. An additional assumption is that it is possible to extract historical data that are necessary to empirically estimate the various model parameters.

2. It is not the intention of this study to interfere with the internal work scheduling activities of each department. Work scheduling will remain the responsibility of the production and maintenance control supervisors within each department. The intention of the proposed model is to enhance the capability of each department to meet serviceable item requirements.

3. The model is designed to conform to the declared policy of I. A. F. Headquarters. This policy states that:

a. The Air Force must be prepared to sustain combat operations for a period of X days. This requirement defines the levels at which the various serviceable items must be maintained.

b. The consumption of serviceables in X fighting days is equivalent to the consumption in Y peacetime days.

c. Each major system has the same essentiality to the Air Force. For example, no difference in essentiality is specified

among fighter aircraft, transport aircraft, and missiles.

d. Because of the high level of readiness that the Air Force must maintain, every effort must be made to minimize the not operationally ready-supply (NORS) rate as much as possible, with relatively little attention being given to marginal cost considerations.

4. The proposed model does not address cost versus effectiveness analysis. Exclusion of this kind of analysis is due to the previously described Air Force policy. There is no doubt that in the absence of this policy the development of a model for determining recovery requirements would definitely consider the marginal cost of item recovery. However, I.A.F. policy precludes estimation of the cost of a nonoperational system due to a shortage of recoverable items (NORS).

RESEARCH OBJECTIVE

The objective of this research is to develop a mathematical model that will:

a. determine the quantity of each item to be recovered during each period (a period is defined as the time between two successive computer-prepared reports).

b. determine the priority that should be assigned each recoverable item when scheduling repair activities.

The desirability of being able to accurately forecast future requirements is obvious.

> Many studies of Air Force problems point out one salient fact: An improvement in demand prediction could result in important savings, perhaps more important than could any other single change; even a small improvement is likely to yield significant savings [1:1].

Increased accuracy in demand forecasts will not only result in monetary savings, but will also result in improved operational readiness and effectiveness.

Predictions of future requirements can also affect planned military operations. For example, forecasted requirements that are inaccurately high might result in a planned operating being reduced in strength or, perhaps, even cancelled.

In determining the quantity of each item to be recovered, several factors may be relevant. These factors include:

a. estimates of future consumption

b. total quantities of serviceable items

c. total quantities of repairable items

d. the level of serviceable items necessary to meet combat readiness requirements.

Determination of the priority of each recoverable item is accomplished in accord with I.A.F. policy which states that each major system is as essential as any other. (The proposed model may be easily modified to reflect any changes in this policy.) In

determining a method for establishing priorities, several factors must be considered. These factors include:

a. the number of using bases for each item

b. estimates of future consumption

c. available quantities of recoverable items

d. available quantities of serviceable items

It was concluded that in order to achieve the main research objective it would be necessary first to accomplish the following:

a. Identify the factors that affect the model.

b. Find the relative weight of each factor in the model.

RESEARCH QUESTION

The major question addressed by this study may be stated as follows:

Can a mathematical model be developed which will, when embedded within an existing computerized management information system, provide department managers at the Israeli Air Force central maintenance depot with periodic reports that specify:

a. the quantity of each repairable item that must be recovered during the next period, and

b. the priority, or relative essentiality, of each repairable item.

CHAPTER II

METHODOLOGY

GENERAL OVERVIEW AND DESCRIPTION OF THE MODEL

As stated previously the objective of this research is to develop a mathematical model that will: (a) determine the quantity of each item to be recovered during a certain period, and (b) determine the priority that should be assigned to each recoverable item.

The variables that are taken into consideration by the model can be classified into two categories:

a. Deterministic variables

b. Stochastic variables

Deterministic Variables--Deterministic variables are those variables whose values can be obtained directly from the CIMS. Values for these variables are entered into the model as they appear in the data base of the CIMS. For example: number of repairable items on hand.

Stochastic Variables--Values for the stochastic variables representing item demand are predicted using a mathematical forecasting model that will be discussed later. Predicted values of this variable

are entered into the model in addition to values for the deterministic variables.

In our assessment, the ability of the proposed model to accurately forecast item demand is a major factor in effectively determining the quantity of each item to be recovered each period as well as the priority of each item.

DEFINITION OF TERMS

1. Depot Level Recoverable Item--This is an item that can be repaired/overhauled only at the depot level. Repair of a depot level recoverable item is not authorized at the base level. Such items are sent immediately to the depot. This item is identified in the computer files by code No. 81.

2. Recoverable Item Warehouse (RIW)--This is a warehouse that operates within the jurisdiction of the depot. The warehouse functions as a central point to which all recoverable items are forwarded from the operational units.

3. Depot Shop (DS)--This is a workshop within the depot that is responsible for a particular class of recoverable items.

4. Class--A group of items whose recovery requires similar equipment and knowledge, e.g. wheel and brake components.

DEFINITION OF VARIABLES

1. Consumption of item j (C_j)--The quantity of the j^{th} item actually consumed by users. This variable is divided into four categories:

a. Monthly Consumption (C_{ij})--The quantity of the j^{th} item consumed in month i (i=1, 2... 36). This information is stored in current data files for the last 36 months.

b. Yearly Consumption (C_{kj})--The quantity of item j consumed during the k^{th} year, where k is the number of years the item has been used in the Air Force. Yearly consumption data are available in historic files for every year since 1969.

c. Predicted Consumption (C_{pj})--The predicted consumption of item j for the next period.

d. Predicted Quantity Level (Q_{pj})--The predicted quantity of item j that is consumed in Y peacetime days (which is equivalent to X combat days).

2. Total Serviceable Quantity (Q_{sj})--The total serviceable quantity of item j in the Air Force.

3. Total Repairable Quantity (Q_{rj})--The total repairable quantity of item j in the Air Force.

4. Priority (P_j)--The essentiality of item j relative to other items repaired in the same shop during a certain period.

5. Quantity to be Recovered (X_{cj})--The quantity of item j that must be recovered during the next period.

6. Dispersion Ratio (D_j)--The ratio of the total number of serviceable items to the number of users.

POPULATION OF INTEREST

This research focuses upon a population that is characterized by:

a. recoverable items with code 81, and

b. items that have achieved a stable trend of demand behavior. The size of this population is estimated to be approximately 10,000 items.

DATA REQUIREMENTS

As previously stated, the population of interest is assumed to have achieved a stable trend of demand behavior. Consequently, the data pertain to those items that have been in operation for at least four years.

The fact that the model contains both deterministic and stochastic variables requires that data be extracted from two different sources:

a. Values for the deterministic variables were extracted from current data files.

b. The data used to determine values for the stochastic variable (the predicted consumption) were extracted from historical files.

The following table defines the variables according to their units of measure and measurement scale.

Table 2-1
Classification of Variables

Description of Variable	Data Source	Units of Data Measurement	Value Level	Measurement Scale
1. Consumption of item j (C_j)	Historical and current files in CIMS	Integer	Discrete Infinite	Ratio
2. Monthly consumption (C_{ij})	Historical and current files in CIMS	Integer	Discrete Infinite	Ratio
3. Yearly consumption (C_{kj})	Historical and current files in CIMS	Integer	Discrete Infinite	Ratio
4. Predicted consumption (C_{pj})	Historical and current files in CIMS	To Nearest Unit	Discrete Infinite	Ratio
5. Predicted Quantity (Q_{pj})	Historical and current files in CIMS	To Nearest Unit	Discrete Infinite	Ratio
6. Priority (P_j)	Current file in CIMS	To Nearest Unit	Discrete Limited	Ordinal

Table 2-1 (continued)

Description of Variable	Data Source	Units of Data Measurement	Value Level	Measurement Scale
7. Quantity to be Recovered (Q_{cj})	Current file in CIMS	To Nearest Unit	Discrete Infinite	Ratio
8. Capacity of Depot Shop (W_1)	Current file in CIMS	Integer	Discrete Infinite	Ratio
9. Average Recovery Time (T_j)	Current file in CIMS	One Decimal Point	Continuous	Ratio
10. Dispersion Ratio (D_j)	Current file in CIMS	Two Decimal Point	Continuous	Ratio
11. Total Serviceable Quantity (Q_{sj})	Current file in CIMS	Integer	Discrete Infinite	Ratio
12. Total Repairable Quantity (Q_{rj})	Current file in CIMS	Integer	Discrete Infinite	Ratio

DATA COLLECTION

The research concentrated on three classes of items:

a. Engine components

b. Wheel and brake components

c. Communication system components

The data required for the development of the model proposed in this research were obtained from CIMS output. Samples of each class of item were randomly selected from these data elements. Table 2-2 provides an estimate of the population of each class of items in the population and proposed stratified sample sizes.

Table 2-2
Sample Quantities

Class	Population Size (approximate)	Sample Size (1% population)
1. Engine components	1500	15
2. Wheel and brake components	800	8
3. Communication system components	700	7
Total		30

RESEARCH APPROACH

The research was divided into two parts:

a. research that facilitates accurate prediction of item

demand (see "General Overview and Description of the Model"), and

b. research culminating in the development of the desired model whose output will be used by the depot manager.

Three mathematical forecasting techniques were assessed in an effort to determine which was able to most accurately predict future item demand. The forecasting methods evaluated were:

a. Multiple-linear regression

b. Moving average

c. 1st order exponential smoothing

d. 2nd order exponential smoothing

e. 3rd order exponential smoothing.

The second part of the research was concerned with using the demand predictions, together with values for the deterministic variables that were obtained from current data files, to establish decision rules which determine the quantity and priority of items to be recovered. This part of the research consisted of two steps:

a. Finding the logical relationship between the variables.

b. Using simulation techniques to test these logical relationships when different relative weights are assigned to the variables. A flow chart depicting the research approach is presented in Figure 2-1.

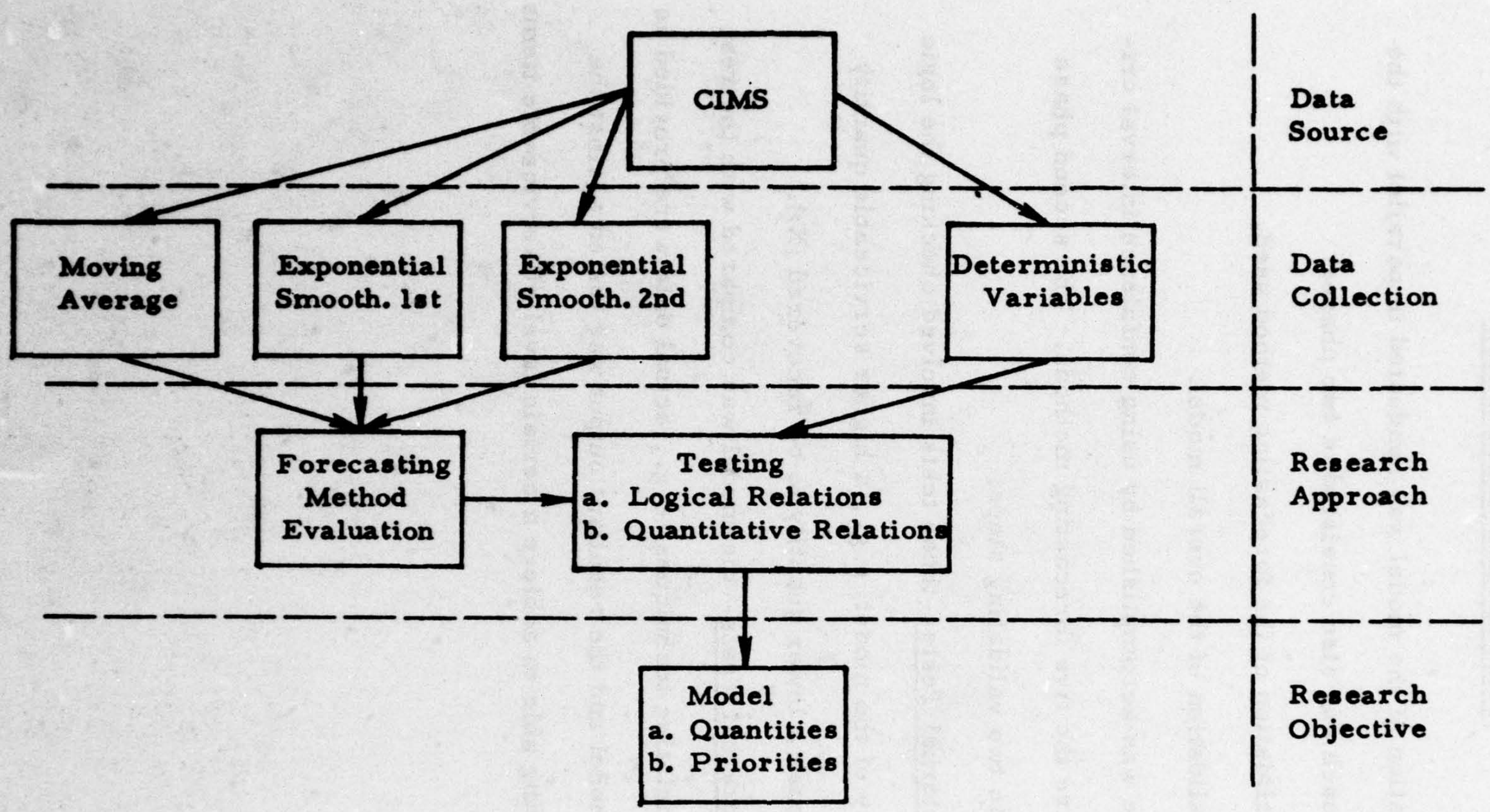

Figure 2-1
Research Approach Flow Chart

VALIDATING THE MODEL

Validation of the model was conducted in parallel with the research approach and also consisted of two phases:

a. Validation of the forecasting method used.

b. Validation of the overall model.

The first phase was accomplished by using confidence interval criteria to compare the five forecasting methods. The second phase was divided into two validating steps:

a. Internal Tests--these tests involved checking the logic and consistency of the model; e.g., a higher serviceable quantity (Q_{sj}) should cause a lower quantity to be recovered (X_j).

b. External Tests--the model was compared with the real world thru simulation techniques; e.g., actual data were provided as inputs to the model and the resultant output was tested against the criterion of being able to achieve a certain level of serviceable items.

CHAPTER III

DEVELOPMENT OF THE FORECASTING MODEL

INTRODUCTION

The objective of this chapter is to compare several methods used to forecast recoverable items demand requirements. This problem is important due to the excessive cost incurred as a result of inaccurate forecasts. Inaccurate prediction of recoverable items demand results in two types of unnecessary costs. Associated with predicting a requirement much greater than actually needed are the costs of acquisition and of storage or disposal of unused items. When the predicted requirement is less than the actual demand, excessive reordering costs are incurred. More importantly, the level of mission readiness will be adversely affected.

To make a prediction of demand for recoverable items, it is necessary to know what demand has been in the past. The data used for making forecasts of recoverable items consumption is obtained from items of the same class.[1]

---

[1]Class is defined as a group of recoverable items which need the same knowledge and equipment while repaired.

The performances of five commonly used forecasting methods will be compared. These five methods are:

a. Moving Average

b. First order exponential smoothing

c. Second order exponential smoothing

d. Third order exponential smoothing

e. Multiple-linear regression.

TIME SERIES MODEL

A set of ordered observations of a quantitative variable taken at successive points in time is called a time series. Time in terms of years, months, days, or hours is simply a device that enables one to relate all phenomena to a set of common, stable reference points.

A typical time series may be thought of as being made up of four types of fluctuations.

1. A trend component which may be defined as long term growth or decay.

2. A seasonal component which may be defined as a regularly recurring periodic fluctuation.

3. A cyclical component which may be defined as a wave-like fluctuation about trend. The length and the cycle are not constant as in the seasonal component but may vary from one cycle to the next.

4. An erratic or random component which is completely unsystematic.

If the letters T, S, C, and E are used to represent the four components of trend, seasonal, cyclical, and erratic fluctuations, respectively, the time series Y, may be written in two basic models.

1. The multiplicative model in which $Y = T \times S \times C \times E$

2. The additive model in which $Y = T + S + C + E$

Moving Average

The moving average is the simplest forecast procedure for time series analysis or forecasting. This method damps noise by averaging several pieces of data. By updating the average sequentially by adding in each new piece of data while dropping off the oldest, process changes can be gradually tracked. According to this procedure the current average is the forecast for all future periods, but unfortunately the moving average lags considerably more abrupt changes in the time process; e.g. an n-period moving average will not reflect completely a step change for n-periods.

Let X_t represent the observations at time t where $t = 1, 2, \ldots N$. The number of the most recent observation as used in the single moving average is N. Then the actual average of the N most recent observations, taken at time t is

$$M_t = \frac{X_t + X_{t-1} + X_{t-2} + \ldots X_{t-N+1}}{N}$$

Each of the past N observations is weighted 1/N; all the older observations receive zero weight. For the next period, the

data includes the newest observation, X_{t+1}, and excludes the oldest observation X_{t-N+1}.

$$M_{t+1} = \frac{X_{t+1} + X_t + \ldots X_{t-N+2}}{N}$$

Thus the data base remains N periods behind the forecast periods, deleting the oldest data found and adding the newest observation to the data base. This accounts for the terminology, moving average.

First Order Exponential Smoothing

Exponential smoothing is so named because the weights assigned to demand observations are constructed by raising a fraction to successively higher powers or exponents. Exponential smoothing is also known as exponential forecasting, adaptive forecasting, adaptive smoothing or geometrical smoothing.

Exponential smoothing is a special kind of moving average that does not require keeping a long historical record in the active file and thus reduces the data-processing time required. Like other moving averages, it has a response to change which does not fluctuate rapidly, but the rate of response can be adjusted readily. (This rate of response is explained in greater detail below.) Exponential smoothing is deemed appropriate if the data follow the constant time series model as represented by the equation

$$X_t = a + \epsilon_t$$

where

X_t is the observation at time t

a is a constant

ε_t is the random fluctuation.

Building the Model. The fundamental idea of exponential smoothing is that any new estimate of demand is based on an old estimate corrected for current information. The estimating equation is:

$$\text{New estimate} = (\text{old estimate}) + \alpha\ (\text{new demand} - \text{old estimate}) \tag{1}$$

or

$$\text{New estimate} = \alpha\ (\text{new demand}) + (1-\alpha)\ (\text{old estimate}) \tag{2}$$

The new estimate is a smoothed value and is equal to the previous smoothed value plus a fraction $\underline{\alpha}$ of the difference between the new observation and the previous smoothed value. Letting $\underline{S_t(x)}$ equal the new estimate or smoother value at time $\underline{t}$, α equal the smoothing constant, and $\underline{X_t}$ equal the latest observation at time $\underline{t}$, equation (2) becomes

$$S_t(x) = \alpha X_t + (1-\alpha) S_{t-1}(x) \tag{3}$$

The choice of the smoothing constant $\underline{\alpha}$ is arbitrary and is covered in depth later. The data-processing simplicity is obvious, since only

one number $S_{t-1}(x)$ has to be recorded instead of the actual demand in each of the past N months. The data for the past N months are combined to yield $S_{t-1}(x)$ in the following manner:

$$\begin{aligned} S_t(x) &= \alpha X_t + (1-\alpha) S_{t-1}(x) \\ &= \alpha X_t + (1-\alpha)[\alpha X_{t-1} + (1-\alpha) S_{t-2}(x)] \\ &= \alpha X_t + \alpha(1-\alpha) X_{t-1} + (1-\alpha)^2 [\alpha X_{t-2} + (1-\alpha) S_{t-3}(x)] \\ &= \alpha X_t + \alpha(1-\alpha) X_{t-1} + \alpha(1-\alpha)^2 X_{t-2} + \ldots \\ &\quad + \alpha(1-\alpha)^n X_{t-n} + \ldots + (1-\alpha)^t X_0 \end{aligned} \tag{4}$$

The function $S_t(x)$ is a linear combination of all past observations. Since the expectation of the function is equal to the expectation of the data, the *function can* be called an average. Thus, there is a new way of estimating the value of the coefficient in a constant model.

$$\hat{a}_t = S_t(x) \tag{5}$$

Selecting the Smoothing Constant. The analysis of the factors that influence the choice of the smoothing constant (or the number of the periods of data that are average) is basic to the concept of making a satisfactory compromise between stability of the forecasts and the speed of response to changes in the model that represents the data.

The value chosen for the smoothing constant α determines what effect various data points have upon the estimate of the average. As in the case of the moving average, the more past data included in

the average, the smaller the error in the estimate--provided, of course, that the basic pattern of demand does not change during the interval. On the other hand, if fewer past periods are included in the averaging process, the response is faster to the changes that do occur.

As a practical matter the choice of α would usually be arrived at by trial and error using a sample of actual past demand or usage data. An α would be tried; the errors could be calculated and compared with other α's. The value of α minimizing error variance would then be a good choice.

__Weighting past data__. Recall that the smoothing constant controls the number of past observations that have any effect on the forecast. The smoothing constant α can take on any value from (but not including) 0 to 1. When α is chosen very close to 0, this is essentially equivalent to using an arithmetic average over a long period of time as the best estimate of the future usage rate. When α is 1, the formula reduces to using the current period's usage rate as a forecast or estimator. Intermediate choices for α produce forecasts which give more or less emphasis to long-run average versus current usage, depending on whether α is chosen closer to 0 or to 1.

For a first order exponential smoothing model, the weight attached to historical observations decreases exponentially according to $(1-\alpha)^k$, $k = 0, 1, \ldots, n$.

Rate of response as a function of α. The response of the forecast to changes in the time series is a function of the relative size of α. The lower α, the slower the response. Higher values of α cause the smoothed average to react quickly--not only to real changes but also to random fluctuations.

Average age of the data. One way to define an exponential smoothing system that is equivalent to an N-period moving average is to say that the smoothing constant is selected to give the same average age of the data. In a moving average scheme, each of the N most recent observations is weighted equally by 1/N, and all prior observations are weighted zero. Let the average age of the data used in a moving average be defined as

$$\overline{K} = \frac{0 + 1 + 2 + \ldots + N-1}{N} = \frac{N-1}{2} \tag{6}$$

The average age is the age of each piece of data used in the average, weighted as the data of that age would be weighted. In the exponential smoothing process, the weight given data k periods ago is $\alpha(\beta)^k$, where $\beta = 1-\alpha$. Hence, the average of the age data is

$$\overline{k} = 0\alpha + 1\alpha\beta + 2\alpha\beta^2 + \ldots$$

$$= \alpha\sum_{k=1}^{\infty} k\beta^k = \beta/\alpha = (1-\alpha)/\alpha \tag{7}$$

Therefore, to determine a single moving average (SMA) or single exponential smoothing (SES) process of equal average age of data, when α in SES of N in SMA, respectively, is known, solve

$$\frac{1-\alpha}{\alpha} = \frac{N-1}{2} \text{ or } \alpha = \frac{2}{N+1} \tag{8}$$

It is not sufficient to equate the average ages, however, as the SMA weights the data equally, and the SES process places heavy weight on the most recent observations and less on the older.

<u>Initial Conditions</u>. Repeating Equation (3)

$$S_t(x) = X_t + (1-\alpha) S_{t-1}(x)$$

it will be noticed that exponential smoothing always requires a previous value of the smoothing function. When the process is started, there must be some value that can be used as the previous value $S_{t-1}(x)$. If there are past data at the time one starts to use exponential smoothing, then the best initial value would be a simple average of the most recent N observations: $S_{t-1} = M_{t-1}$ initially.

Frequently, there is no past data to average; smoothing starts with the first observation. In this case, a prediction of the average is required. The prediction may be what the process is intended to do. In other cases, the prediction can be based on similarity with other processes that have been observed for some time, as in the case of

a new item added to an inventory.

Summary of Single Exponential Smoothing. Exponential smoothing is one of the simplest yet most flexible methods of forecasting demand from past observations. It is accurate. It is simple, at least by comparison with any moving average technique, requiring only two multiplications and one addition and using only two pieces of data, the forecast and the observation for the latest period. It is flexible because the weight assigned to each period's observation can be easily changed. Thus exponential smoothing meets both criteria of (1) simplicity of computation, and (2) flexibility to adjust the rate of response.

The demand pattern must fit the constant model represented by equation (1). If the demand pattern exhibits a linear trend, i.e., the process is changing at a steady rate, the forecasts made with SES will lag behind the actual time series observations. This lag can be corrected by introducing a trend component into the forecasting equation. This is accomplished in double exponential smoothing (DES).

Second Order Exponential Smoothing

The fundamental equation is

$$S_t(x),\ 2 = \alpha S_t(x),\ 1 + (1-\alpha) S_{t-1}(x),\ 2$$

Estimates of the coefficients of the first order polynomial (linear) model are obtained from the first and second order smoothed statistics.

$S_t(x), 1$ and $S_t(x), 2$, through the following equations

$$\hat{b}_0(t) = 2\, S_t(x), 1 - S_t(x), 2$$

$$\hat{b}_1(t) = \left(\frac{\alpha}{1-\alpha}\right)[S_t(x), 1 - S_t(x), 2]$$

the initial conditions to start smoothing are:

$$S_0(x), 1 = X(0) - \left(\frac{1-\alpha}{\alpha}\right) \hat{b}_1(0)$$

$$S_0(x), 2 = X(0) - 2\left(\frac{1-\alpha}{\alpha}\right) \hat{b}_1(0)$$

where $\hat{b}_1(0)$ is an initial estimate of the slope at $t = 0$.

The general equation for the forecast is

$$S_t(T) = b_0(t) + b_1(t)(T-t)$$

Note: Selecting the smoothing constant α is done by the same procedure described in the first order exponential smoothing.

Third Order Exponential Smoothing

The fundamental equation is

$$S_t(x), 3 = \alpha S_t(x), 2 + (1-\alpha)\, S_{t-1}(x), 3.$$

Estimates of the coefficient of the second order polynomial (quadratic) model are obtained from the first, second, and third-order smoothed statistics, $S_t(x), 1$, $S_t(x), 2$ and $S_t(x), 3$ through the following equations.

$$\hat{b}_0(t) = 3S_t(x),\ 1 - 3S_t(x),\ 2 + S_t(x),\ 3$$

$$\hat{b}_1(t) = \frac{\alpha}{2(1-\alpha)^2}\ [6-5\alpha)\ S_t(x), 1 - (10-8\alpha)\ S_t(x), 2 + (4-3\alpha)$$

$$(S_t(x), 3)\ ]$$

$$\hat{b}_2(t) = \frac{\alpha^2}{2(1-\alpha)^2}\ [S_t(x),\ 1 - 2S_t(x), 2 + S_t(x), 3]$$

The initial conditions to start the smoothing are:

$$S_0(x), 1 = \hat{b}_0(0) - \left(\frac{1-\alpha}{\alpha}\right)\hat{b}_1(0) + \left[\frac{(1-\alpha)(2-\alpha)}{\alpha^2}\right]\hat{b}_2(0)$$

$$S_0(x), 2 = \hat{b}_0(0) - \frac{2(1-\alpha)}{\alpha}\hat{b}_1(0) + \left[\frac{2(1-\alpha)(3-2\alpha)}{\alpha^2}\right]\hat{b}_2(0)$$

$$S_0(x), 3 = \hat{b}_0(0) - \frac{3(1-\alpha)}{\alpha}\hat{b}_1(0) + \left[\frac{3(1-\alpha)(4-3\alpha)}{\alpha^2}\right]\hat{b}_2(0).$$

The selection of the smoothing constant-α, is similar to that described above.

MULTIPLE-LINEAR REGRESSION

Much of the effort expended in scientific research is devoted to the search of a cause and effect relationship that may exist between phenomena. The process of discovery in this deterministic (cause and effect) mode of inquiry involves learning by association. Events are observed and related, and on the basis of this analysis a decision is made whether the events are related casually. The events analyzed include a set of observed variations of a dependent variable and a set of corresponding variations for each of one or more independent variables.

Regression and correlation are powerful statistical tools that provide quantitative expressions or models of the moment or extent to which events are related mathematically. The application of these statistical methods cannot offer proof of the existence of a causal relationship between selected variables. Statistical analysis of these methods can, however, provide valuable information that the analyst can employ to support a judgment concerning the existence of a cause and effect relationship between the variables selected for analysis.

The problem of making a prediction or an estimate of the value of a dependent variable corresponding to a given value of an independent variable requires that a mathematical expression in equation form be devised to express the relationship between the relevant

variables. This equation is an expression of the functional relationship between the assumed dependent variable and one or more independent variables. The relationship in which a dependent variable can be determined exactly from a selected value of one or more independent variables ($x_1, x_2, x_3, \ldots, x_n$) is described by the functional expression

$$Y = b_1x_1 + b_2x_2 + \ldots b_nx_n.$$

The most appropriate method used to find the coefficients ($b_1, b_2, \ldots, b_n$) of this relationship is the least square method (LSM) which minimizes the sum of the squared differences between the actual values of $\hat{Y}$ and its calculated value from the functional expression Y. In mathematical expression:

$$\text{Min} \sum_{i=1}^{n} (Y-\hat{Y})^2$$

The statistical significance of the overall MLR model and the coefficients ($b_1, b_2, \ldots, b_n$) are derived using the F test and the t test respectively (4:604-633).

METHODOLOGY

Source of Data

The data used in generating the forecasts and in comparing the alternative forecasting methods were actual usage data which

were extracted from the CIMS's files (the computerized inventory system of the IAF).

Description of Data

As stated above, five methods of forecasting are compared in this study. These methods can be divided into two main categories:

a. Multiple-linear regression (MLR)

b. Time series analysis.

MLR Data Requirements--Using the MLR method, future demand is forecast as a function of the following variables.

a. Level of activity (flying hours)

b. Number of major systems in which the observed item is installed.

c. The class to which the observed item belongs.

A stratified sample of 30 items was randomly selected from the following three classes.

Table 3-1
Sample Sizes

Class of Components	Population Size (approximate)	Stratified Sample Size (1%)
Engine	1500	15
Wheel & Brake	800	8
Communication	700	7

Definition of Variables

Y_j - The observed demand of the j^{th} item.

X_{1j} - The observed number of flying hours of the j^{th} item.

X_{2j} - The number of major systems in which the j^{th} item is installed in.

X_{D1j} - Is a dummy variable which defines the class of the j^{th} item--will be "1" if it belongs to the "engine" class and "0" otherwise.

X_{D2j} - Is a dummy variable which defines the class of the j^{th} items--will be "1" if it belongs to "wheel & brake" components and "0" otherwise.

Table 3-2 illustrates the assignment of values to dummy variables.

Table 3-2
Identification of Dummy Variables

Class \ Dummy Variable	X_{D1}	X_{D2}
Engine	1	0
Wheel & Brake	0	1
Communication	0	0

Note: The number of dummy variables is the number of classes minus one.

This model considers only the independent variables which were mentioned above; however, in our assessment, other independent variables such as number of landings, type of mission, number

of missions, may possibly influence the dependent variable. These variables were not considered because they were not available from our data source.

Time Series Data Requirements--In the time series analysis, 24 values of observed demand were used to forecast the future demand, (24 months of past consumption). These values were obtained for one item of each class that was mentioned previously.

MLR Analysis Approach

The analysis of the MLR model employed an existing library program, MLREG, which uses LSM. This program enabled us to:

1. Determine the coefficients of the following regression equation

$$y = b_0+b_1x_1+b_2x_2+b_{D1}x_{D1}+b_{D2}x_{D2}$$

2. Test the significance of overall model.

3. Test the significance of the regression equation coefficients.

4. Find the net or marginal contribution of each variable to the model's explanatory power.

Time Series Analysis Approach

The analysis of the time series method required the use of two computerized programs:

1. SLSC/Moving, R--for the moving average.

2. Sl. LIB/TCAST--for the exponential smoothing model.

The first program used 24 data points to forecast the demand for the 25th month using a moving average model with N = 2, 4, 6, 9, 12. For each of the five moving averages, the mean absolute deviation (MAD was recorded). The optimal moving average model was the one with the minimum MAD.

The second program (TCAST) forecasted the demand in the 25th month (lead time = 1) with different values for α (α = (0.04, 0.08, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9) and for each of the three exponential smoothing models. The preferred model (optimum α, type of smoothing, optimal cyclic behavior) was obtained by observing the minimum MAD.

MLR Results Analysis

a. The significance of the overall model was tested thru the F statistic which was computed as the ratio of the mean square regression (MSR) to the mean square error (MSE). A higher F statistic indicates a higher significance level of the overall model.

b. The significance of each coefficient of the regression equation was tested by means of a t-statistic which was computed as the ratio of the coefficient value to its standard deviation. A higher t-statistic results in a higher significance level of this coefficient existing in the model.

c. The localized or stepwise contribution of each variable to the explanatory power of the model is available from the computer output because the program selects the variable to be introduced next on the basis of its explanatory power.

d. The validity of the model was tested by observing the number of actual values which fell within the forecast confidence interval for each forecasted value.

The confidence interval for a single future observation of the process at x^0 (simple linear regression model) was computed using the following formula (for the $(1-\alpha)$ 100% confidence level).

$$\text{C.I.} = \hat{Y}\Big|_{x^0} \pm t_{\alpha/2,\, df=n-2}\ \hat{\sigma}_{y\cdot x}\sqrt{1+\frac{1}{n}+\frac{(x^0-\bar{x})^2}{\sum(x-\bar{x})^2}}$$

where

$\hat{Y}\Big|_{x^0}$ is the forecast value at the point x^0

$t_{\alpha/2,\,n-2}$ is the appropriate value extracted for the t distribution with a significance level of α and $n-2$ degrees of freedom

$\hat{\sigma}_{y\cdot x}$ is the estimate of the standard deviation of dependent variable Y

n is the number of observations

$\bar{x}$ is the mean of the independent variable.

This approach can be expanded to more than two dimensions. When the confidence interval is defined in more dimensions than can be

visualized, calculations become easier when matrix algebra is used.

The interested reader can consult Applied Linear Statistical Models by Neter and Wasserman, p. 245, for a complete explanation of the matrix approach to solving multiple linear regression models.

The confidence intervals were computed using an existing computer program--MREG, R. This program splits the data base into two parts (according to a pre-selected percentage), and builds an MLR model from one part and computes confidence intervals for remaining data points.

Time Series Results Analysis

The results of the time series forecasting method were analyzed for one randomly selected item from each class mentioned above as follows:

a. For the moving average method the optimal N (number of observations used to compute the moving average) was extracted from the computer output for each item. The optimal N was the one with the minimum observed MAD.

b. For the exponential smoothing method the preferred type of smoothing and optimal α were observed for each item. These values were provided as an output by the program and in fact were chosen according to the minimum MAD method.

c. The optimal parameters for these two methods were then compared as follows:

(1) The minimum MAD for each item pointed out the minimal absolute deviation forecasting method. However, it should be noted that this procedure does not necessarily lead to the best method, because of the possibility of it being inefficient.

(2) The predictive efficiency of each method was tested by observing the number of actual values which "fell" within the confidence interval for each forecasted value. The model with the highest efficiency level was accepted.

Comparison Analysis of MLR and Time Series

The comparison between the MLR model and the Time Series models was accomplished through two methods.

a. Comparison between the MAD for each class (in the time series model this class is represented by one item).

b. Comparison of efficiencies between the "most efficient" time series model and the MLR model. The flow chart in Figure 3-1 describes the process of analyzing MLR and time series results.

PRESENTATION AND INTERPRETATION OF RESULTS

MLR Results Presentation and Interpretation

The regression equation that was obtained from the computer output was

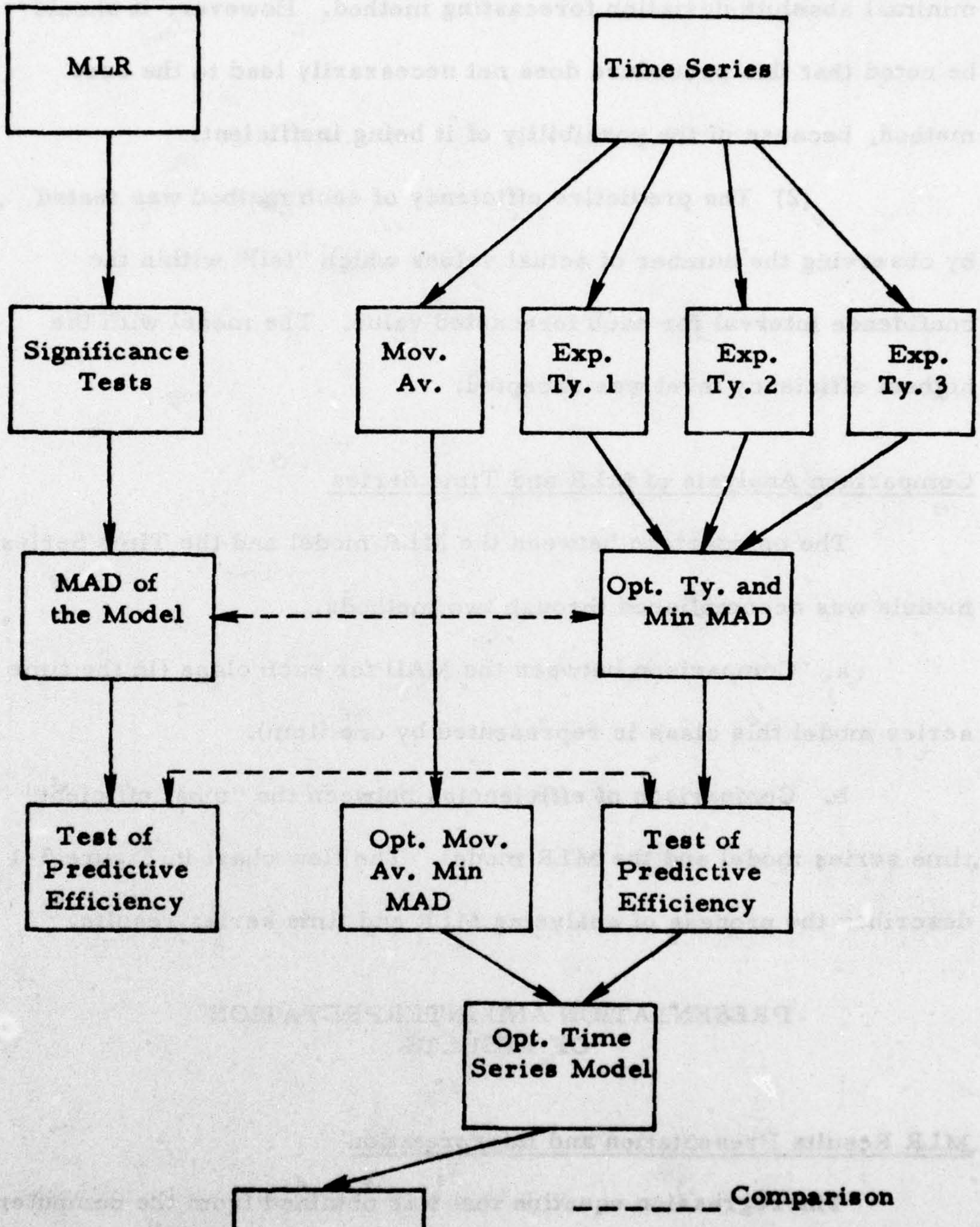

Figure 3-1
Process of Results Analysis

$$\hat{y} = 3.74811 + 0.00061 x_1 + 0.01223 x_2 + 3.18313 x_{D1} + 12.15841 x_{D2}$$

where

$\hat{y}$ is the forecasted demand

x_1 is the number of flying hours

x_2 is the number of major systems

x_{D1} is the dummy variable which defines "engine" class

x_{D2} is the dummy variable which defines "wheel & brake" class.

1. Significance of the overall model--Table 3-3 illustrates the variance analysis of the model.

Table 3-3
Analysis of Variance

	Variation	D. F.	Mean Square	F Statistics
Explained Variation-EV	803.277496	4	200.819374	6.802002
Unexplained Variation-UV	738.089772	25	29.523567	
Total Variation-TV	1541.366669	29		
Coefficient of Determination $R^2 = 0.5211463$				

The critical value of F in a confidence level of 90% is 2.18. The appropriate H.T. involving R^2 (the significance of the model) is

$H_0: R^2 = 0$ $\qquad F_S = 6.802002$

$H_1: R^2 \neq 0$ $\qquad F_C = 2.18$

$4, 25, \alpha = 0.10$

$F_S > F_C$ - reject H_0 and conclude that the overall model is significant at a 90% C. L.

2. Significance of the Coefficients--Table 3-4 presents the t statistics for the different coefficient.

Table 3-4
t Statistic

Var	Value	t Statistics	$t_c = t_{25}, \alpha = 0.10$
B_0	3.74811	0.64460	1.708
B_1	0.00061	0.06302	1.708
B_2	0.01223	0.52482	1.708
B_{D1}	3.18813	1.05767	1.708
B_{D2}	12.15841	3.68490*	1.708

The appropriate H. T. involving each B_j is

$$H_0: B_j = 0$$

$$H_1: B_j \neq 0$$

Rejection of the null hypothesis will mean that the marginal contribution of the X_j is significant at a C. L. of 90%.

$$t_c = t_{25, 0.10} = 1.708$$

The conclusion of this test is that only the dummy variable X_{D2} (wheel and brake class) is significant.

3. Contribution of each variable to the explained variation (E.V.) of the model--Table 3-5 presents the contribution of each variable to the E.V. of the model.

Table 3-5
Explained Variation for Regression Model

Model	E.V.	ΔE.V.	R^2	ΔR^2
$\hat{y} = B_0 + B_1x_1$	37.528168	37.528168	0.0243473	0.0243473
$\hat{y} = B_0 + B_1x_1 + B_2x_2$	398.889069	361.360601	0.2587892	0.2344419
$\hat{y} = B_0 + b_1x_1 + B_2x_2 + B_{D1}x_{D1} + B_{D2}x_{D2}$	803.277496	404.388427	0.5211463	0.2623571

The conclusions from Table 3-5 are:

a. The variable X_1 (flying hours) has a meaningless contribution to the explanatory power of the model.

b. The variables that contribute most are the dummy variables which represent the association of the items to different classes.

c. The variable X_2 (number of major systems) has a meaningful contribution to the explanatory power--in contrast to the activity level (X_1--flying hours).

The conclusion that flying hours contribute a meaningless amount to the explanatory power of the model is not surprising since

several studies have indicated that little or no correlation exists between demand and the activity level. For example, Denicoff and Haber, in a study conducted in 1962, found that there was a measurable relationship between demand and flying hours in only 3% of the items observed (2:9). In a similar study conducted by Denicoff it was concluded that for most items demand projections based on flying hours would be futile (3:2).

Studies by the Rand Corporation indicate that a major problem in determining the existence of a relationship between demand and program activity, such as flying hours, may be caused by a time factor. Demand for a particular item may, in fact, be highly correlated with flying hours but if the service life of the part is quite long, the demand figures will not follow the month-to-month fluctuations in flying hours (1:86).

In our assessment, the fact that the number of major systems was found to be a contributory variable to the model must be investigated more deeply in order to be able to draw correct conclusions about its explanatory power. The reason for this assessment is that no statistically significant conclusions can be drawn from the sample that we observed, because of its small size in comparison to the population size. (The availability of data sources restricted the sample size to 30 observations.)

The fact that the classification of the population (dummy variables) has the most net or marginal explanatory power can be

explained by the fact that there is a correlation between the demand and a certain class of items. However, we cannot conclude that a statistically significant relationship exists because of the limitations on sample size.

4. <u>Measuring predictive efficiency of the model</u>--As previously stated, the measurement of predictive efficiency was carried out using the MREG program. The data were randomly split to 80/20 percent (80% used to build the model). Table 3-6 presents the results.

Table 3-6
Confidence Intervals for Regression Model

Y	$\hat{Y}$	C.I.
4	7.43	13.29
10	8.74	14.55
14	7.25	15.30
7	5.17	13.05
12	7.33	13.92
8	7.05	13.14

The large values of the C.I. obtained (approximately 2 times larger than the nominal values) "ensure" that each predicted value "falls" in the interval. Therefore we can obviously conclude that the process of measuring predictive efficiency of the MLR model is meaningless.

It should be noted that these results were not unexpected due to the low coefficient of determination ($R^2 = 0.52$) which indicated that the prediction power of the model is low.

5. <u>Deviations of the model</u>--The deviation values of the model are shown in Table 3-7. y represents the actual observed value, $\hat{y}$ represents the forecasted value and $|y-\hat{y}|$ represents the absolute deviate.

Table 3-7
MLR Model Deviations

No.	y	$\hat{y}$	$\|y-\hat{y}\|$
ENGINE			
1	4	7.59	3.59
2	3	8.4	5.4
3	2	7.86	5.86
4	4	8.25	4.25
5	6	8.25	2.25
6	10	8.43	1.57
7	12	7.80	4.20
8	11	7.20	4.80
9	10	8.25	1.75
10	9	7.68	1.32
11	14	7.47	6.53
12	8	7.35	0.65
13	11	8.34	2.66
14	12	7.53	4.47
15	3	7.59	4.59
WHEEL & BRAKE			
16	22	19.71	2.29
17	25	17.94	7.06
18	31	19.53	11.47
19	19	17.61	1.39
20	23	18.18	4.82

Table 3-7 (continued)

No.	y	$\hat{y}$	$\lvert y-\hat{y} \rvert$
WHEEL & BRAKE (continued)			
21	9	18.50	9.50
22	7	18.67	11.67
23	1	4.04	3.04
COMMUNICATION			
24	4	3.97	0.03
25	6	4.06	1.94
26	8	4.02	3.98
27	9	4.11	4.89
28	9	4.06	0.06
29	13	12.68	4.68
30	7	4.08	3.92
		TOTAL	124.63
		MAD	4.154

Table 3-8 presents the MAD values calculated for each <u>class</u> using the MLR model

Table 3-8
Summary of MAD Values - MLR

Class	MAD
Engine	3.592
Wheel & Brake	6.405
Communication	2.795

The values of Table 3-8 were subsequently used to compare MLR and time series smoothing models.

Time Series Results Presentation and Interpretation

1. Moving average--Table 3-9 presents the MAD results that were obtained from the computer output.

Table 3-9
Summary of MAD Values - Moving Average

Class / N	N=1	N=2	N=4	N=6
Engine		3.70455	3.33750	3.04000
Wheel & Brake	3.86956	4.11364	4.32500	5.16667
Communication	2.65217	2.72727	3.22500	3.61111
Class / N	**N=9**	**N=12**	**N=15**	**N=18**
Engine	2.54815	2.000	2.36296	
Wheel & Brake	6.46667	7.11111	8.97778	
Communication	3.20000	3.06250	3.00747	3.85185

Conclusions--

a. for the engine class the optimal model was found for N=12, when N is the number of observations used to compute the moving average.

b. for the wheel and brake class the optimal model was found for N=1.

c. for the communication components the optimal model was found for N=1.

An interesting conclusion can be drawn from the results obtained for the two last classes. When N=1 the equivalent α is $1\left(\frac{2}{1+1}\right) = 1$ which means:

a. No weight is given to the values of previous data except for the last value.

b. The forecasted demand for period i+1 is the demand for period i.

c. The interpretation of (a) and (b) is that the forecasted demand is a memoryless process.

2. Exponential Smoothing--The minimum MAD was obtained for each of the classes by the remaining smoothing models. This information is presented in Table 3-10.

Table 3-10
Minimum MAD Values - Exponential Smoothing

Class / Model	Type of Smoothing	α	Cycle	Minimum MAD
Engine	1	0.8	4	2.51160
Wheel & Brake	1	0.6	1	2.98078
Communication	1	0.5	11	0.76464

Conclusions--The fact that first order exponential smoothing was determined to be optimal for all three classes suggests that the demand has no trend component and the forecasted demand fluctuates randomly relative to a certain constant that depends on the specific model (specific α, and cycle) for each class.

Time Series Comparison Analysis--

a. A comparison of minimum MAD for the optimal models is given in Table 3-11.

Table 3-11
MAD Values for Time Series Comparison

Class / Optimal Model	Moving Average	Exponential Smoothing
Engine	2.0*	2.51160
Wheel & Brake	3.86956	2.98078*
Communication	2.65217	0.76474*

The results shown in Table 3-11 indicate that the exponential smoothing models are "better" (depends on the predictive efficiency test) than the moving average for the last two classes. As for the first class (engine) we can conclude that the moving average model is more appropriate; however, statistically significant conclusions cannot be drawn because of inappropriate sample sizes.

b. The predictive efficiency test of the exponential smoothing model for C. L. = 90% is shown in Table 3-12. y represents the actual observed value, y represents the forecasted value, and y-y represents the absolute deviate.

Table 3-12
Predictive Efficiency Test of Exponential Smoothing Model

	Engine				Wheel & Brake				Communication			
Time	y	$\hat{y}$	$\lvert y-\hat{y}\rvert$		y	$\hat{y}$	$\lvert y-\hat{y}\rvert$		y	$\hat{y}$	$\lvert y-\hat{y}\rvert$	
6	9	5.62	3.38	*	11	10.43	0.57	*	6	5.60	0.40	*
7	15	12.02	2.98	*	14	10.78	3.22	*	9	7.47	1.53	*
8	13	12.65	0.35	*	12	12.71	0.71	*	6	7.90	1.90	*
9	2	11.37	9.37		13	12.28	0.72	*	8	8.28	0.28	*
10	4	3.84	0.16	*	19	12.71	6.29	*	9	12.48	3.48	
11	16	7.67	8.33		18	16.48	1.52	*	3	8.74	0.26	*
12	12	12.58	0.58	*	18	17.39	0.61	*	5	4.87	0.13	*
13	11	10.56	0.44	*	17	17.76	.26	*	2	5.05	3.05	
14	10	10.88	0.88	*	6	17.3	11.30		0	2.86	2.86	
15	8	13.88	5.88		15	10.52	4.48	*	1	1.09	0.09	*
16	10	7.42	2.58	*	13	13.20	0.20	*	5	5.05	0.05	*
17	13	7.92	5.08	*	11	13.08	2.08	*	6	6.36	0.36	*
18	12	11.95	0.05	*	23	11.83	11.17		7	7.85	.85	*
19	14	15.69	1.69	*	25	18.53	6.47	*	8	7.09	0.91	*

Table 3-12 (continued)

Engine					Wheel & Brake				Communication			
Time	y	$\hat{y}$	$\|y-\hat{y}\|$		y	$\hat{y}$	$\|y-\hat{y}\|$		y	$\hat{y}$	$\|y-\hat{y}\|$	
20	15	12.58	2.42	*	29	22.41	6.59	*	9	8.88	0.12	*
21	11	12.96	1.96	*	24	26.37	2.37	*	15	13.23	1.77	*
22	8	11.36	3.36	*	30	24.95	5.05	*	6	6.14	0.14	*
23	12	12.37	0.37	*	29	27.98	1.02	*	8	8.07	0.07	*
24	10	10.32	0.32	*	29	28.59	0.41	*	9	8.15	0.85	*
Total			50.16				65.55				19.1	
MAD 2.64					MAD 3.45				MAD 1.005			
C.I. 90% = ± 5.44					C.I. 90% = ± 7.11				C.I. 90% = ± 2.079			

*Means actual value "falls" in C.I.

$$\text{C.I. } 90\% = K_{90\%}\text{MAD} \qquad K_{90\%} = 2.062$$

__Conclusions__--Table 3-13 summarizes the efficiency levels obtained for each class.

Table 3-13
Efficiency Levels - Summary

Class	No. of * A	No. of Observations B	Percentage A/B x 100	C. L.
Engine	16	19	84.2%	90%
Wheel & Brake	17	19	89.4%	90%
Communication	16	19	84.2%	90%

From this table we see that the model is most efficient for the wheel and brake class. However, the differences are too small to conclude any significant variation between the classes.

COMPARISON OF MLR MODEL AND TIME SERIES MODEL

1. Comparison of MAD Values

Table 3-14 shows the different MAD values obtained for each class for the compared models.

Table 3-14
MAD Values - MLR and Time Series Comparison

Class / Model	MLR	Time Series	Remarks for Time Series
Engine	3.592	2.0*	Moving Average
Wheel & Brake	6.405	2.98078*	Exponential Smoothing
Communication	2.785	0.76474*	Exponential Smoothing

Conclusion--The table values indicate that in each case the time series model is better than the MLR model (using the minimum MAD as the criterion).

2. Comparison of efficiency

The results of the efficiency test of each model disclosed the following:

a. The efficiency measurement for the MLR model is meaningless (see page 47, paragraph 4).

b. The time series model demonstrated high predictive efficiencies (84.2%, 89.4%, 84.2%).

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this chapter we conclude that the time series forecasting technique is more accurate than MLR technique.

The fact that applying this technique is also less complicated and cheaper than the MLR technique (less data, fewer variables) brings us to the conclusion that time series techniques are preferable to the MLR technique in forecasting future demand of recoverable items. Therefore, this forecasting method is used in the next chapter as an input for development of our general model.

It should be noted again that the conclusions and the recommendation in this chapter were based upon a small sample. The methods and comparison techniques shown in this chapter can be used as an appropriate tool for a deeper research in this area.

CHAPTER IV

DEVELOPMENT OF THE MODEL

Introduction

As stated in previous chapters, the model developed in this research is intended to determine two basic outputs, the quantity to be recovered in the next period, and the priority to be assigned to each item. These will serve as inputs to the depot shop manager's decision making process.

Determination of the Quantity to Be Recovered

In determining the quantity of each item to be recovered the following variables are considered.

a. The main input factor--the predicted consumption of each item in the next period (C_p) as developed in Chapter III.

b. The total quantity of serviceable items at a given time (Q_s).

c. The number of consumption periods (A) established by Air Force policy for building a desired level of serviceable quantity needed for future consumption. The future consumption is a function of the predicted number of war-days.

d. The number of periods in which the desired level of serviceable quantity will be reached through the recovery process (B).

The quantity to be recovered in the next period is divided into two categories:

a. The serviceable quantity (Q_s) is less than the desired level stated in the Air Force Policy ($A \cdot C_p$).

b. The serviceable quantity (Q_s) is greater than the desired level.

In the first case, the quantity to be recovered in the next period (X) is divided into two elements:

1. The quantity which compensates for the consumption in the next period (C_p).

2. The relative part of the desired serviceable quantity level which will be built in the next period

$$\frac{AC_p - Q_s}{B}$$

in which:

$A \cdot C_p$ is the desired serviceable quantity level

Q_s is the serviceable quantity in stock

$(A \cdot C_p - Q_s)$ represents the quantity to be repaired in order to achieve the desired serviceable quantity

B is the number of "building" periods.

The total quantity to be recovered will be

$$X = C_p + \frac{A \cdot C_p - Q_s}{B}$$

In the second case the serviceable quantity is already greater than the desired level. In order to prevent a decreasing trend in the serviceable level, equation (2) was developed.[1]

$$X = 2C_p \qquad (2)$$

At first glance, it would appear that in order to maintain the existing serviceable quantity, the planned quantity to be recovered should be equal to the consumption of the next month ($X = C_p$). However, when we consider the fact that the actual recovered quantity equals at most the planned quantity we can definitely conclude that using $X = C_p$ would result in a continual deterioration of the serviceable quantity. Therefore, equation (2) is used in this case. The coefficient for C_p in this equation was found through simulation to be the minimum satisfactory value.

Determination of the priority of each recoverable item accomplished in accordance with I.A.F. policy which states that each

---

[1]When $Q_s \geq AC_p$ then $X \leq C_p$. In addition, the quantity which is actually recovered would never be greater than the planned quantity so that the actual recovered quantity would not be sufficient to compensate for the amount consumed during the next period. This situation would definitely cause deterioration of the serviceable quantity.

major system is as essential as any other. (The proposed model may be easily modified to reflect any changes in this policy.)

Two variables established the priority for each item.

a. The serviceable quantity (Q_s)

b. The predicted consumption in the next period (C_p).

The priority designator (P_j) for item j is defined as the ratio between these two variables.

$$P_j = \frac{Q_s}{C_p} \tag{3}$$

From this equation, we see that a high priority designator is a result of a high Q_s and/or low C_p, and a low priority designator is a result of a low Q_s and/or high C_p. A low priority designator therefore reflects a high essentiality and vice versa.

Description of the Model

Figure 4-1 presents a flow chart that describes the process by which X_j and P_j are determined.

In addition to the variables that are considered in equations (1) and (2), the following variables are included in the development of the general model.

a. The total repairable quantity (Q_r)

b. The number of users in the Air Force (N)

c. The dispersion ratio (D_j) which is calculated as the ratio of the total serviceable quantity ($X+Q_s$) to the number of users (N).

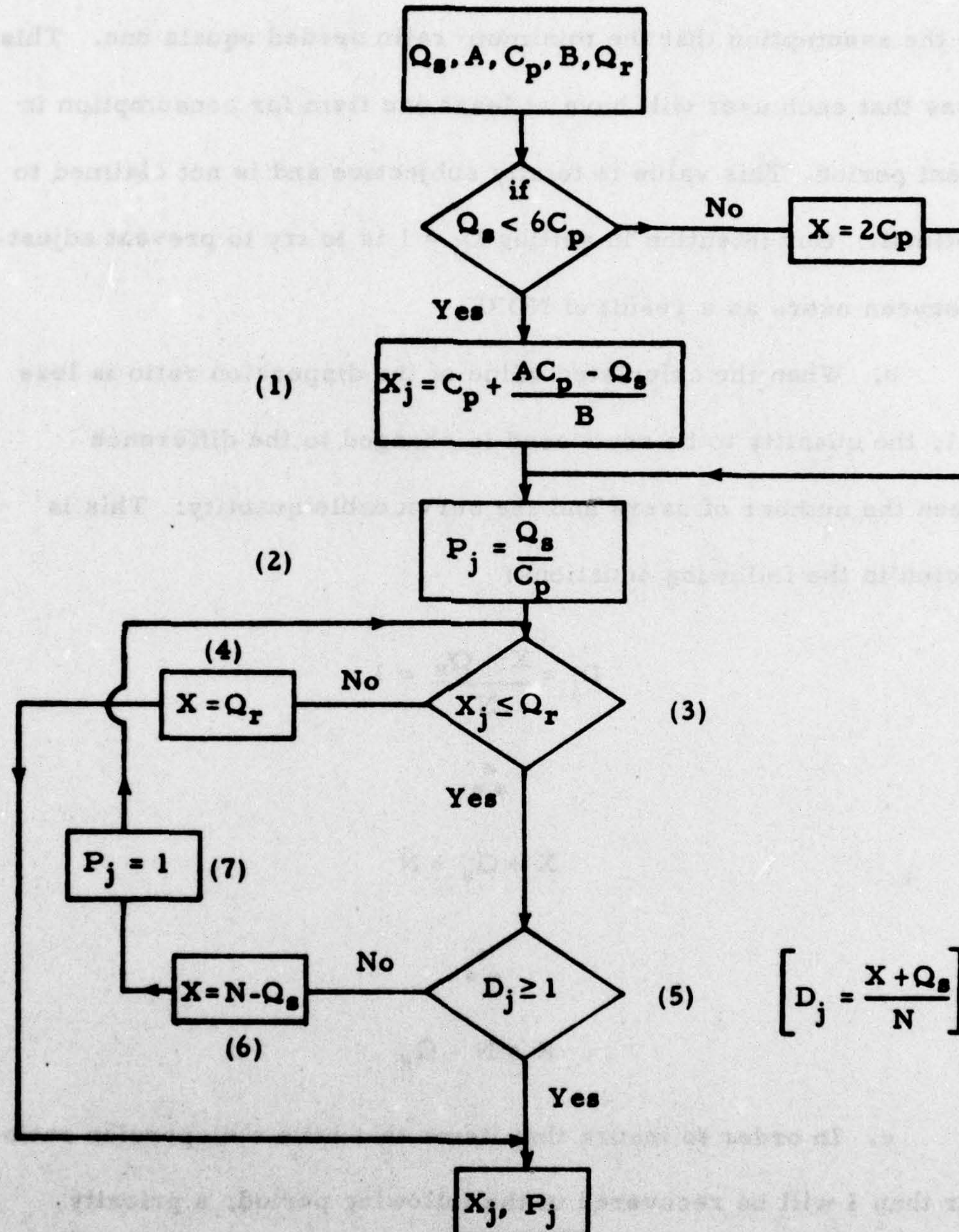

Figure 4-1
Flow Chart of the Model

Notes

a. In considering the dispersion ratio in the model, we made the assumption that the minimum ratio needed equals one. This insures that each user will have at least one item for consumption in the next period. This value is totally subjective and is not claimed to be optimal. Our intention in setting $D_j = 1$ is to try to prevent adjusting between users as a result of NORS.

b. When the calculated value of the dispersion ratio is less than 1, the quantity to be recovered is changed to the difference between the number of users and the serviceable quantity. This is reflected in the following equations:

$$D_j = \frac{X + Q_s}{N} = 1$$

$$\therefore$$

$$X + Q_s = N$$

$$\therefore$$

$$X = N - Q_s$$

c. In order to insure that items that have a dispersion ratio lower than 1 will be recovered in the following period, a priority designator of 1 is assigned to these items.

d. The capacity of the depot shop was not considered in the model because the model considers each item separately.

The capacity of each depot shop is taken into consideration while comparing the total number of hours needed to complete the recovery program in the next period. When the total quantity of hours needed is higher than the depot shop capacity, the depot shop manager will schedule the items according to their priority designators (i.e. the order of recovering will be from the lower numbers to the higher numbers until his capacity is saturated. However, when his capacity is greater than the total quantity of hours neede he must finish all of the program.

e. The two factors, A and B, which reflect the desired level of serviceable quantity and its "building" rate, are totally subjective and are determined as stated in the inventory management policy of the I.A.F.

The present policy states that both A and B are equal to 6, i.e. the desired level of serviceable quantity is for 6 months consumption, and this level should be achieved at the most in six months of the recovery process.

CHAPTER V

VALIDATION OF THE MODEL

The validation of the model is conducted in two successive steps.

1. Internal tests--includes checking the logic and consistency of the model.

2. External tests--includes comparing model outputs with real world data through a computer simulation. This requires that actual data be provided as inputs to the model and the resultant output then be tested against the criterion of being able to achieve the specified level of serviceable quantity.

Internal Test

The following internal tests refer to the flow chart of the model in Chapter IV (see Figure 4-1, page 61).

1. Step 1 $$X_j = C_p + \frac{AC_p - Q_s}{B}$$

In this equation we see that:

a. As the predicted consumption goes up (C_p) the quantity to be recovered (X_j) goes up also and vice versa.

b. As the serviceable quantity (Q_s) goes up the quantity to be recovered (X_j) goes down, and vice versa.

c. As the number of consumption periods (A) goes up the quantity to be recovered also goes up and vice versa.

d. As the "building" period (B) goes up the quantity to be recovered (X_j) goes down, and vice versa.

2. Step 2 $$P_j = \frac{Q_s}{C_p}$$

In this equation we see that as the serviceable quantity (Q_s) goes up the priority designator (P_j) value goes up also (i.e. low essentiality of the item and vice versa. As the predicted consumption (C_p) goes up the priority designator (P_j) value goes down (i.e. high essentiality of item) and vice versa.

3. Steps (3) ($X_j \leq Q_r$) and (4) ($X = Q_r$) insure that the quantity to be recovered will never exceed the total repairable quantity.

4. Steps (5) ($D_j \geq 1$), (6) ($X = N - Q_s$) and (7) ($P_j = 1$) insure that whenever D_j is less than 1, the quantity to be recovered (X_j) will be such that each user will have a quantity of one of that item, and it will be assigned the highest essentiality level ($P_j = 1$).

<u>External Test</u>

The following flow chart describes the external process of validating the model through computer simulation techniques.

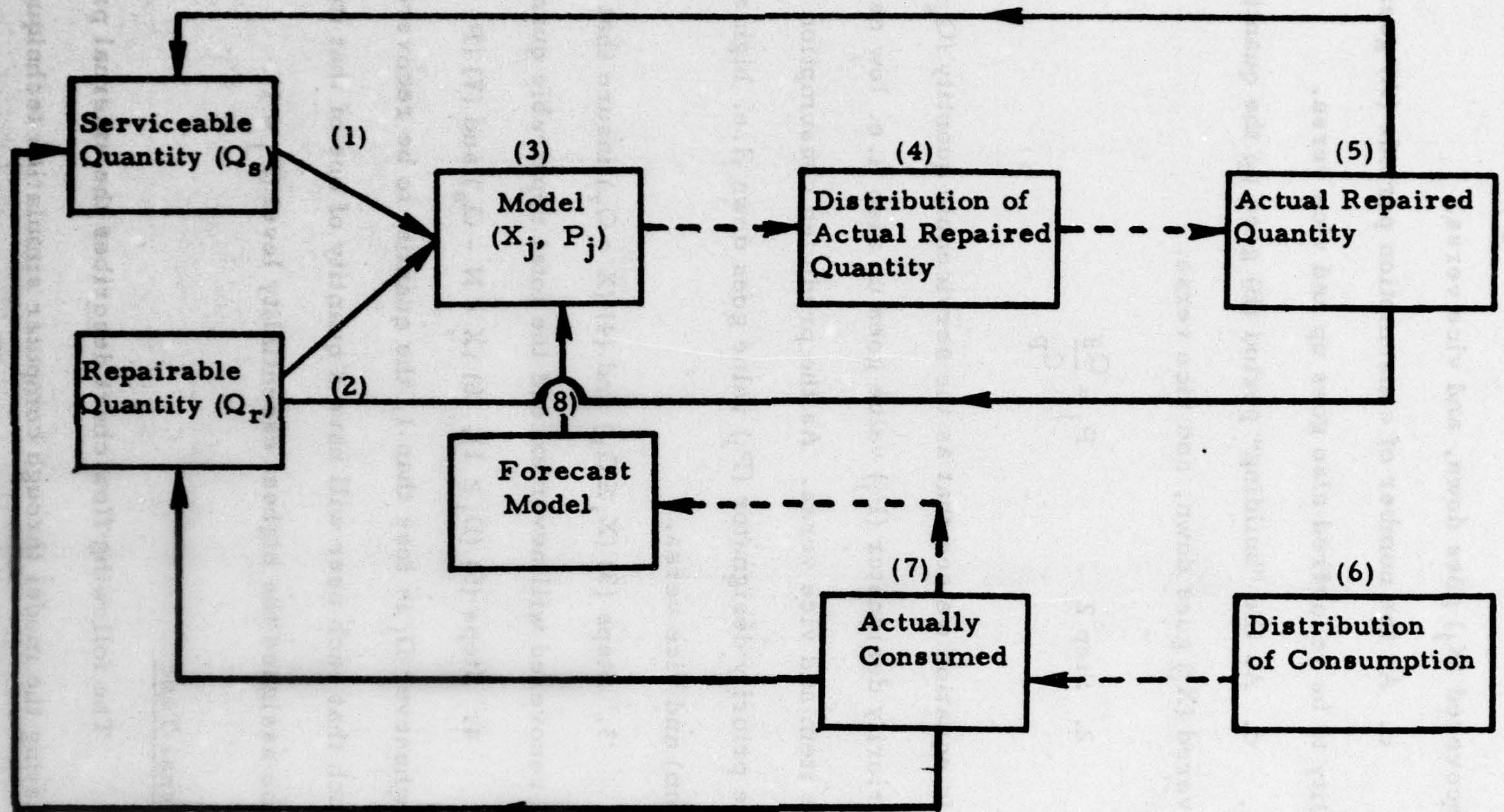

Figure 5-1
Simulation Flow Chart

Explanations

1. The process starts with two actual values of a certain item Q_s--the serviceable quantity, and Q_r--the repairable quantity (see Steps (1) and (2)).

2. In Step (3) the quantity to be recovered (X_j) and its priority (P_j) are determined by the model.

3. The actual recovered quantity (Step (5)) is derived from an experimental distribution that was built from historical data (description of the distribution is given on the following pages), and influences the new serviceable quantity and repairable quantity.

4. The actual consumed quantity (Step (7)) is derived from a Poisson distribution with a mean (λ) that was computed from historical data (for more details see page 71), and influence the predicted consumption, the repairable quantity and the serviceable quantity.

Actual Recovered Quantity Distribution

This distribution gives the actual quantity repaired as a function of the quantity which was planned (X_j). It was derived from 500 double data points (planned vs actual) which enabled us to build the experimental distribution.

The 500 data points were gathered by taking 20 months of past data (planned vs actual quantity) for 25 different items from each class. The results are shown in Table 5-1 and the histograms presented in Figures 5-2 thru 5-4.

Table 5-1
Grouped Data of the Actual Repaired Quantities

Quantity Class	** X	X-1	X-2	X-3	X-4	X-5	X-6	X-7	X-8 and more*
Engine	252	88	59	37	28	14	8	9	5
Wheel & Brake	255	86	56	42	26	13	9	10	4
Commun-ication	249	85	62	41	25	15	10	9	4
$\sum$	756	259	177	120	79	42	27	28	13

The extreme points of these observations are (X-8) and (X).

*The number of observations beyond the value of (X-8) is small and therefore is added to this group.

**The depot never recovers more than the planned quantity.

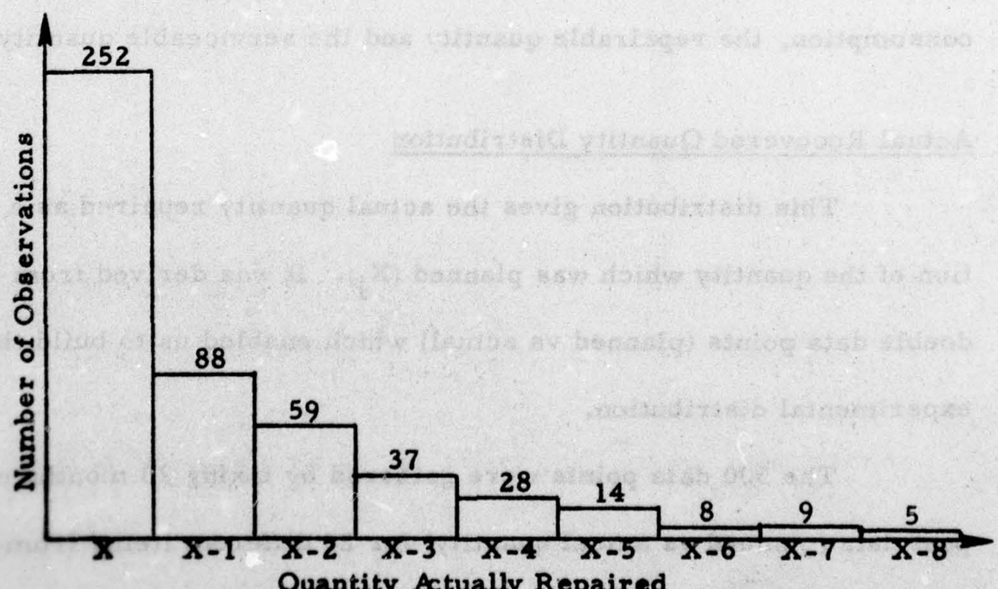

Figure 5-2
Distribution of Quantity Actually Repaired:
Engine Class

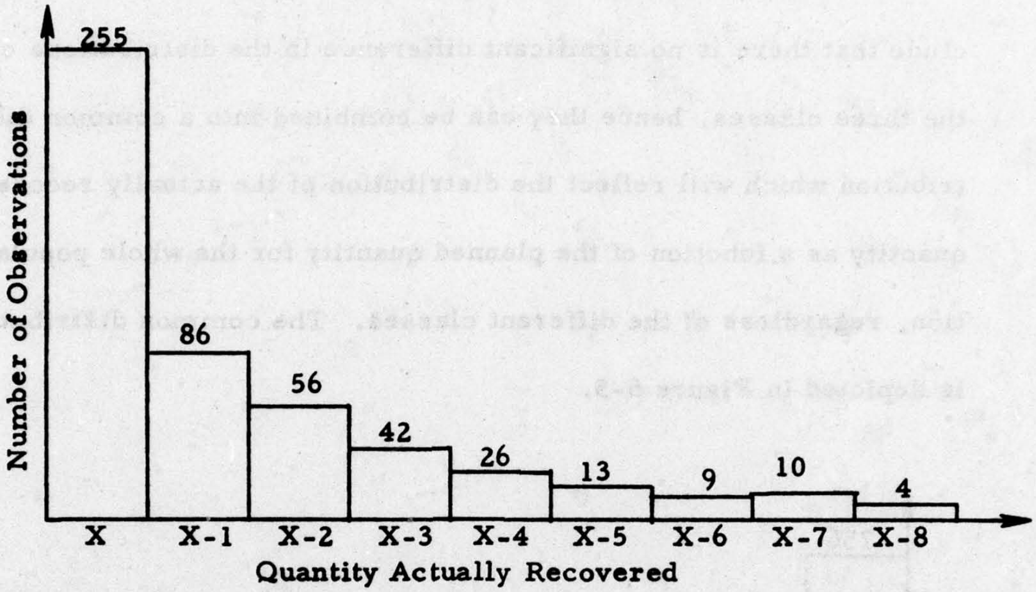

Figure 5-3
Distribution of Quantity Actually Repaired:
Wheel and Brake Class

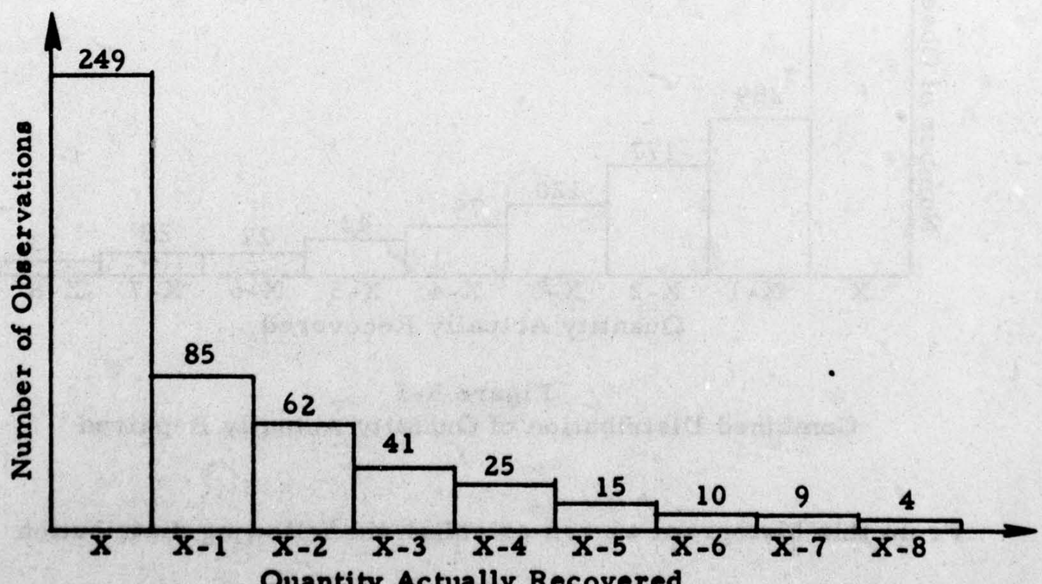

Figure 5-4
Distribution of Quantity Actually Repaired:
Communication Class

From Table 5-1 and the distribution figures, we can conclude that there is no significant difference in the distributions of the three classes, hence they can be combined into a common distribution which will reflect the distribution of the actually recovered quantity as a function of the planned quantity for the whole population, regardless of the different classes. The common distribution is depicted in Figure 5-5.

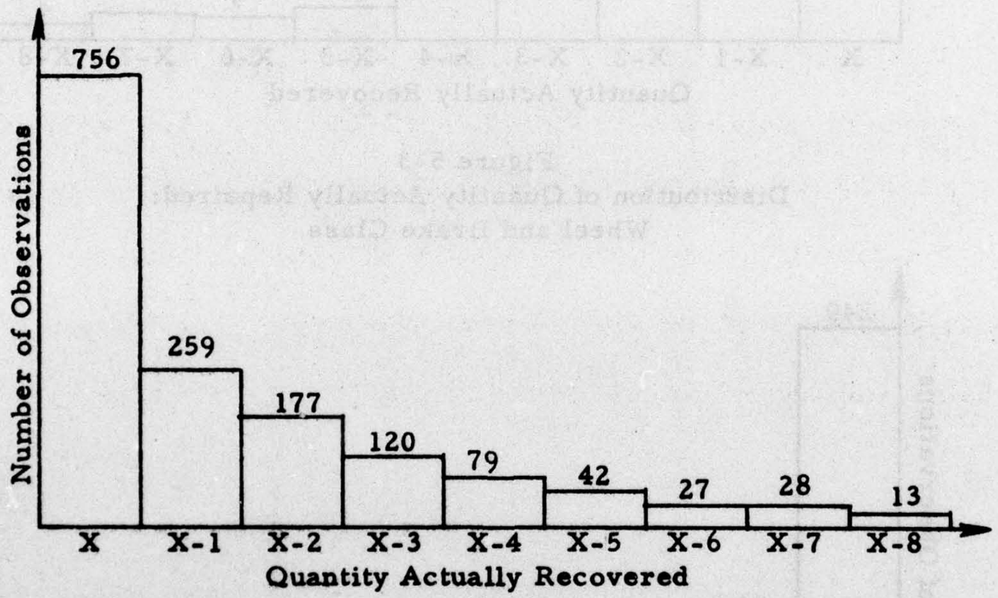

Figure 5-5
Combined Distribution of Quantity Actually Repaired

From this histogram we can establish the following distribution table, Table 5-2.

Table 5-2
Cumulative Distribution Table

Var.	X	X-1	X-2	X-3	X-4	X-5	X-6	X-7	X-8
f(x)	0.50	0.17	0.12	0.08	0.05	0.03	0.02	0.02	0.01
F(x)	0.50	0.67	0.79	0.87	0.92	0.95	0.97	0.00	1.00
R.N.	1÷50	51÷67	68÷79	80÷87	88÷92	93÷95	96÷97	98÷99	100

The Actual Consumption--Poisson Distribution

As previously stated, the distribution of the actual consumption can be described as a Poisson process.

A random variable X is said to have a Poisson distribution if its probability distribution can be written as

$$P\{X = k\} = P_x(k) = \frac{\lambda^{k_1 - \lambda}}{k!} ,$$

where λ is a positive constant and k is any nonnegative integer. It is evident that $P_x(k)$ is nonnegative; and it is easily shown that

$$\sum_{k=0}^{\infty} \frac{\lambda^{k_1 - \lambda}}{k!} = 1$$

The Poisson distribution is often used in Operation Research. Heuristically speaking, this distribution is appropriate in many situations where an "event" occurs over a period of time, like the arrival of a customer. The number of <u>Customer Arrivals</u> in a <u>fixed time</u> is often assumed to have a Poisson distribution. Similarly the <u>demand</u>

for a given product is also often assumed to have this distribution (:318). In our case the number of customer arrivals is the demand and the fixed time is a one month period.

As mentioned previously, our population of interest is assumed to have achieved a stable trend of demand behaviors. Thus we can compute the mean of the demand and assume that it is the mean (λ) of the Poisson distribution.

CHAPTER VI

DESCRIPTION OF THE MODEL AND THE SIMULATION PROCESS

This chapter describes how the processes that were developed in Chapters IV and V are combined into one model.

Figure 6-1 presents a flow chart that describes this combined model.

Explanations

1. The initial data that starts the process is:

a. Q_s--the serviceable quantity at this point in time.

b. Q_r--the repairable quantity at this point in time.

c. C_p--the forecasted demand for the next period (computed through time series analysis--See Chapter III).

d. N--the number of users.

e. Alpha--the smoothing coefficient for this item (see Chapter III).

f. QLamda--the mean of the demand distribution (Poisson).

g. NPNTS--the number of simulation loops.

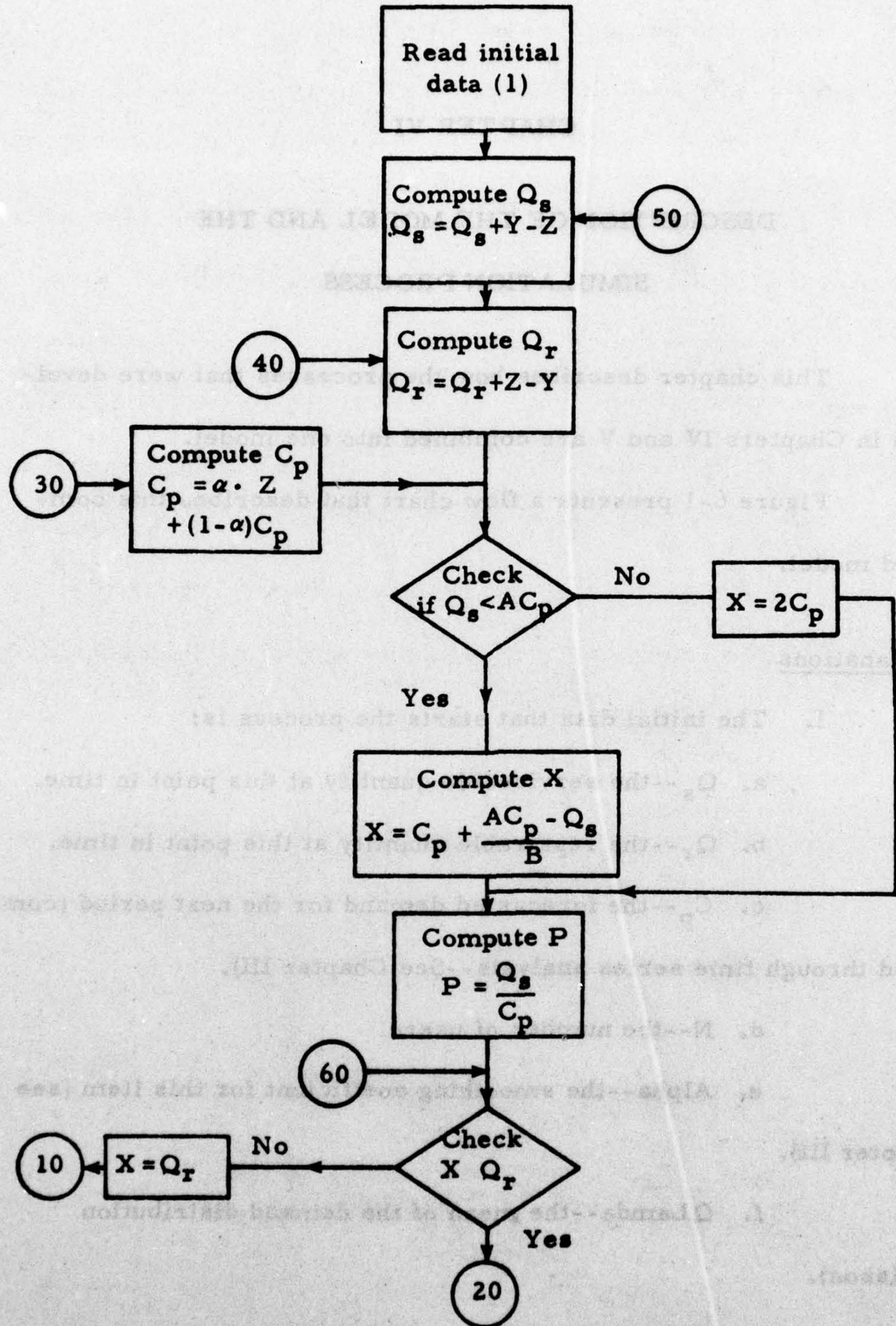

Figure 6-1
Simulation Model Flow Chart

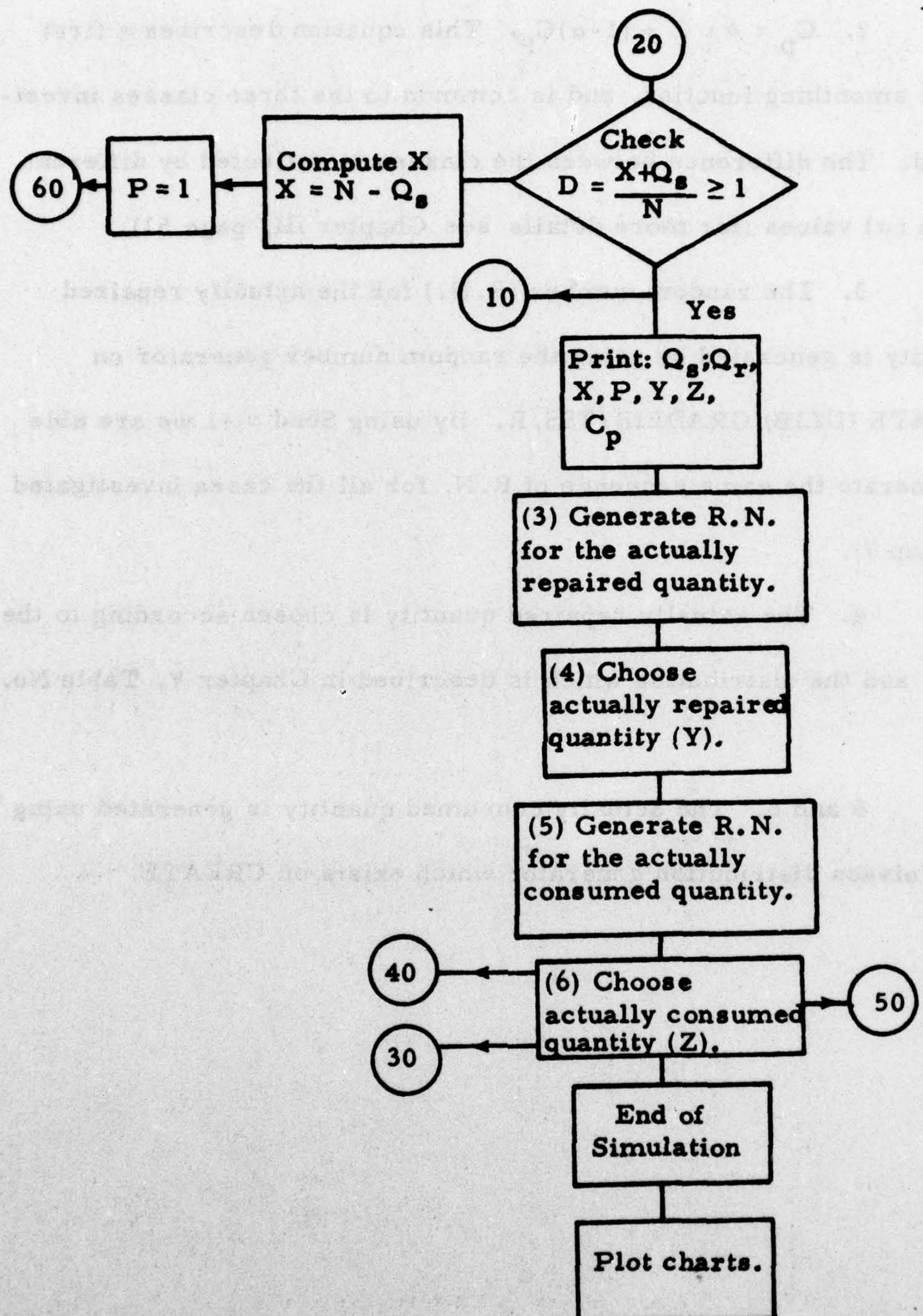

Figure 6-1 (continued)

2. $C_p = \alpha \cdot Z + (1-\alpha)C_p$. This equation describes a first order smoothing function, and is common to the three classes investigated. The difference between the classes is reflected by different Alpha (α) values (for more details see Chapter III, page 51).

3. The random number (R.N.) for the actually repaired quantity is generated by using the random number generator on CREATE (ULIB) GRADLIB/TSS,R. By using Seed = +1 we are able to generate the same sequence of R.N. for all the cases investigated (7:Chap 7).

4. The actually repaired quantity is chosen according to the R.N. and the distribution which is described in Chapter V, Table No. 5-2.

5 and 6. The actually consumed quantity is generated using the Poisson distribution generator which exists on CREATE.

CHAPTER VII

SIMULATION RESULTS AND CONCLUSIONS

Introduction

In this chapter we describe the results of the simulation.

The process was simulated for each class of items (engine, wheel and brake, communication). In each class we examined six different initial situations, which can be classified into two main groups:

a. high serviceable quantity and low repairable quantity

b. low serviceable quantity and high repairable quantity.

The first group is a test case examining the ability of the model to prevent deterioration of the existing level of serviceable quantity (see Chapter IV, page 59).

The second group is a test case which examines the ability of the model to build a serviceable quantity up to a desired level ($A \cdot Q$) within a desired number of periods (B). Each group is divided into three situations:

a. $\lambda < C_p$, which means that the mean of the future consumption distribution is lower than our initial prediction.

b. $\lambda = C_p$, which means that the mean of the future consumption distribution equals our initial prediction (which is the case of reaching a stable trend of behavior).

c. $\lambda > C_p$ which means that the mean of the future consumption distribution is higher than our initial prediction.

The differentiation between the three classes of items is done by using the three different smoothing factors (α's) which were obtained in the time series analysis (see Chapter III, page 51). Those three α's lead to the difference between the predicted future consumption (C_p) for each class.

$$C_p = \alpha \cdot Z + (1-\alpha)C_p$$

Initial Simulation Data

Table 7-1 gives the initial data points used.

Table 7-1
Initial Data Points of the Simulation

Class	Q_s	Q_r	C_p	λ	α	NPNTS *	A **	B **	N
Engine	50	5	5	2	0.8	100	6	6	5
	2	30	5						
	50	5	5	5					
	2	30	5						
	50	5	5	8					
	2	30	5						
Wheel & Brake	50	5	5	2	0.6	100	6	6	5
	2	30	5						
	50	5	5	5					
	2	30	5						
	50	5	5	8					
	2	30	5						
Communication	50	5	5	2	0.5	100	6	6	5
	2	30	5						
	50	5	5	5					
	2	30	5						
	50	5	5	8					
	2	30	5						

*NPNTS is the number of simulation periods, which in our case is 100 months (more than 8 years into the future). The high number was chosen in order to prevent the influence of initial conditions and to study the behavior of the model in the long run.

**A = B = 6 is chosen because the existing policy of the Air Force is to build a serviceable quantity for six months of consumption in a period of six months.

In addition to the previous situations which were examined in accordance with the existing Air Force policy, we checked another situation with different stated policies:

a. A = 6, B = 3.

This policy requires building a serviceable quantity for six months of consumption in a period of 3 months (a higher rate of building the desired level in comparison to the existing Air Force policy).

b. A = 12, B = 6.

This policy requires building a serviceable quantity for 12 months of consumption in a period of 6 months (a higher desired serviceable level in comparison to the existing Air Force policy).

The simulation computer program and the simulation results (quantitative and descriptive-graphs) are presented in Appendix A.

Results Analysis

The results analysis refers to the initial data which is presented in Table 7-1. From the results we can see that the differences between the three groups under investigation are minor and do not influence the model's ability to operate in the expected manner. This fact enables us to analyze the results of one group and make a general conclusion about the behavior of the model concerning all three classes.

Situation #1

$Q_s = 50$

$Q_r = 5$

$C_p = 5$

$\lambda = 2$

$\alpha = 0.5$

NPNTS = 100

A = 6

B = 6

N = 5

This initial situation represents a high level of serviceable quantity, a low level of repairable quantity and a low average consumption level relative to the initial C_p. As expected, we see that the level of serviceable quantity is not significantly changed in comparison to the initial condition. This allows us to assume that the model does not "permit" deterioration of the high serviceable quantity.

Situation #2

$Q_s = 2$

$Q_r = 30$

$C_p = 5$

$\lambda = 2$

$\alpha = 0.5$

NPNTS = 100

A = 6

B = 6

N = 5

This initial situation represents a low level of serviceable quantity, a high level of repairable quantity and a low average

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consumption level relative to the initial C_p. As expected we see that the model "builds" the serviceable quantity to the desired level ($Q_s = 6C_p$) in six months, and then continues to improve this quantity as much as possible (the upper limit is the total quantity of this item).

Situation #3

$Q_s = 50$

$Q_r = 5$

$C_p = 5$

$\lambda = 5$

$\alpha = 0.5$

NPNTS = 100

A = 6

B = 6

N = 5

This initial situation represents a high serviceable quantity, a low repairable quantity and a median level of consumption equal to the initial C_p. As expected, we see that the model behaves very similarly to Situation No. 1.

Situation #4

$Q_s = 2$

$Q_r = 30$

$C_p = 5$

$\lambda = 5$

$\alpha = 0.5$

NPNTS = 100

A = 6

B = 6

N = 5

This initial situation represents a low serviceable quantity, a high repairable quantity and a median level of consumption equal to the initial C_p. As expected, we see that the model behaves very similarly to Situation #2.

<u>Situation #5</u>

$Q_s = 50$

$Q_r = 5$

$C_p = 5$

$\lambda = 8$

$\alpha = 0.5$

NPNTS = 100

A = 6

B = 6

N = 5

This initial situation represents a high serviceable quantity, a low repairable quantity and a high average consumption level relative

to the initial C_p. As expected, we see that the model behaves very similarly to Situations #1 and 3.

<u>Situation #6</u>

$Q_s = 2$

$Q_r = 30$

$C_p = 5$

$\lambda = 8$

$\alpha = 0.5$

NPNTS = 100

A = 6

B = 6

N = 5

This situation represents a low serviceable quantity, a high repairable quantity and a high average consumption level relative to the initial C_p. As expected, we see that the model behaves very similarly to Situations #2 and 4.

<u>Situation #7</u>

$Q_s = 2$

$Q_r = 30$

$C_p = 5$

$\lambda = 2$

$\alpha = 0.5$

NPNTS = 100

A = 12

B = 6

N = 5

This situation is similar to Situation #2 in its initial conditions except for the change in the value of A. We examined this situation to see how a change in the desired level of serviceable quantity ($A * C_p$) is reflected in the behavior of the model. According to the results we see that the rate of building the desired serviceable quantity is higher than the case in Situation #2; i.e., n this situation we see that after a six month period we reach a serviceable quantity of $Q_s = 27.4$ while in Situation #2 we reached a quantity of $Q_s = 14.5$. However, it should be stated that in the long run the process stabilizes for the two situations around the same level of serviceable quantity ($Q_s \simeq 28$).

Situation #8

$Q_s = 2$

$Q_r = 30$

$C_p = 5$

$\lambda = 2$

$\alpha = 0.5$

NPNTS = 100

A = 6

B = 3

N = 5

This situation is similar to Situation #2 in the initial conditions, except for the change in the value of B. We examined this situation to see how the model responds to a change in the desired "building period" (B). According to the results, we see that the rate of building the serviceable quantity increases; i.e., in this situation it was observed that after a three month period we reach a serviceable quantity of Q_s = 18.3 while in Situation #2 we reached a quantity of Q_s = 11.7. However, it should be stated that in the long run the process stabilizes for both situations around the same level of serviceable quantity ($Q_s \simeq 28$).

<u>General Conclusions</u>

According to the results analysis we see that the model behaves as expected.

1. In all cases where we specified initial conditions of high serviceable quantities and low repairable quantities the end result was that the serviceable quantity was not deteriorating and, moreover, the maximum possible serviceable quantity was achieved.

2. In all cases where we had initial conditions of low serviceable quantities and high repairable quantities, the model built the serviceable quantity and reached the desired level within the specified amount of time, (i.e. according to the values of A and B). In the long

run, the model continued to build the serviceable quantity and stabilized it around the maximum possible level.

3. In establishing priority designators for all the cases we were able to identify a similar trend of behavior. When the serviceable quantity (Q_s) goes up, the repairable quantity (Q_r) goes down and the priority value goes up, which means a lower essentiality is assigned to that particular item.

The priority designators give the depot shop manager an indication as to how he should schedule, within the constraint imposed by shop capacity, the repair of various items. We can say that in the case of building serviceable quantity (low Q_s, high Q_r) the priority value influences the scheduling of the item in the shop's workload. According to the results we see that in the short run we have low priority values (high essentiality) in successive periods. This means that this item will be scheduled for repair in successive periods, while in the long run we see that the number of successive periods in which low priority items are repaired goes down (indicating less successive scheduling of repair of the item in the shop workload).

In the case of initial high serviceable quantity and low repairable quantity we see that we obtain a high priority designator which indicates that the item is not expected to be scheduled in the shop (depends on the capacity of the shop).

Summary

According to the conclusions stated above we can say that the model which was developed in this thesis responds as expected for the different situations that were investigated. Thus, the model is a viable tool for implementation in the depot recovery process for repairable items in the Air Force.

Recommendations for Further Research

The following areas are recommended for further research:

a. An investigation of the sensitivity of the model to different dispersion ratios.

b. An investigation of the influence of the distribution of actually repaired quantities on the "building" capability of the model and the sensitivity of the overall model to this distribution.

c. Construction of a similar model incorporating non-linear relationships between the variables.

APPENDIX A

SIMULATION PROGRAM AND RESULTS

```
@RUN *=(ULIB)GRADLIB/TSS,R
C THIS PROGRAM COMPUTES THE RESULTS FOR THE
C SIMULATION PROCESS OF THE MODEL WHICH
C DETERMINES THE QUANTITY TO BE RECOVERED
C IN THE DEPOT IN THE NEXT PERIOD AND ITS
C PRIORITY
      DIMENSION PERIOD(100),QS1(100),QR1(100)
      DIMENSION X1(100),Y1(100),P1(100)
      DIMENSION Z1(100),CP1(100)
      REAL NPNTS
      READ,QS,QR,CP,ALPHA,QLAMDA,NPNTS
      XQS=QS
      XQR=QR
      XCP=CP
      Y=0
      Z=0
      N=5
      PRINT 7001
 7001 FORMAT(//////13X,"***** SIMULATION
     & RESULTS *****"///
     &6X,"QS",5X,"QR",6X,"X",6X,"P",6X,"Y"
     &6X,"Z",6X,"CP",//)
      DO 1 J=1,NPNTS
    1 PERIOD(J)=J
      DO 23 I=1,NPNTS
       QS=QS+Y-Z
       QR=QR+Z-Y
       IF(QS.LT.0.)GO TO 2
       IF(QR.LT.0.)GO TO 3
       GO TO 4
    2  QS=0.
       GO TO 4
    3  QR=0.
    4  P=QS/CP
       E=6*CP
       IF(QS.GE.E)GO TO 5
       X=CP+(6*CP-QS)/6
       GO TO 6
    5  X=2*CP
    6  IF(X.LT.1.0)GO TO 10
    7  IF(X.GE.QR)GO TO 8
       D=(X+QS)/N
       IF(D.LE.1.0)GO TO 9
       GO TO 11
    8  X=QR
```

```
      GO TO 11
    9 X=N-OS
      P=1.0
      GO TO 11
   10 X=1.0
   11 PRINT 7002,OS,OR,X,P,Y,Z,CP
      OS1(I)=OS
      OR1(I)=OR
      X1(I)=X
      P1(I)=P
      Y1(I)=Y
      Z1(I)=Z
      CP1(I)=CP
 7002 FORMAT(5X,7(F4.1,3X)/)
      SEED= +1.0
      RV = RND(SEED)*100+1
      IF(RV.GT.50.0)GO TO 12
      Y=X
      GO TO 9
   12 IF(RV.GT.67.0)GO TO 13
      Y=X-1
      GO TO 9
   13 IF(RV.GT.79.0)GO TO 14
      Y=X-2
      GO TO 9
   14 IF(RV.GT.87.0)GO TO 15
      Y=X-3
      GO TO 9
   15 IF(RV.GT.92.0)GO TO 16
      Y=X-4
      GO TO 9
   16 IF(RV.GT.95.0)GO TO 17
      Y=X-5
      GO TO 9
   17 IF(RV.GT.97.0)GO TO 18
      Y=X-6
      GO TO 9
   18 IF(RV.GT.99.0)GO TO 19
      Y=X-7
      GO TO 9
   19 Y=X-8
   20 CONTINUE
      IF(Y.LE.0.)GO TO 21
      Y=Y
      GO TO 22
```

```
21  Y=0
22  Z= POISSON (QLAMDA,1.)
    CP=ALPHA*Z+(1-ALPHA)*CP
23 CONTINUE
    CALL USTART
    CALL USET("SMALL")
    CALL UDIMEN(12.,12.,"AFIT/LSG 77B
  &TOLIDANO BRAUN\")
    CALL UDAREA(0.,8.5,0.,11.)
    CALL UOUTLN
    CALL UDAREA(1.,7.5,1.,4.25)
    CALL USET("XBOTH")
    CALL USET("YBOTH")
    CALL UPSET("XLAB","PERIOD\")
    CALL UPSET("YLAB","P\")
    CALL UPLOT1(PERIOD,P1,NPNTS)
    CALL LAB(1.5,4.25,1.,55.,"P\")
    CALL UDAREA(1.,7.5,5.75,9.0)
    CALL UPSET("YLAB","QS QR\")
    CALL UPLOT1(PERIOD,QS1,NPNTS)
    CALL UPSET("SETDASH",34.)
    CALL UMOVE(PERIOD(1),QR1(1))
    DO 24 J=1,NPNTS
24  CALL UPEN1(PERIOD(J),QR1(J),"DASH")
    CALL LAB(1.5,9.0,1.,55.,"QS\")
    CALL LAB(1.5,9.0,3.,34.,"QR\")
    CALL USET("DEVICE")
    CALL UMOVE(6.,10.)
    CALL UDOIT("LF01")
    CALL UPRNT1("QS=","TEXT")
    CALL UPRNT1(XQS,"REAL")
    CALL UMOVE(6.,10.)
    CALL UDOIT("LF02")
    CALL UPRNT1("QR=","TEXT")
    CALL UPRNT1(XQR,"REAL")
    CALL UMOVE(6.,10.)
    CALL UDOIT("LF03")
    CALL UPRNT1("CP=","TEXT")
    CALL UPRNT1(XCP,"REAL")
    CALL UMOVE(6.,10.)
    CALL UDOIT("LF04")
    CALL UPRNT1("ALPHA=","TEXT")
    CALL UPRNT1(ALPHA,"REAL")
    CALL UMOVE(6.,10.)
    CALL UDOIT("LF05")
```

```
      CALL UPRNT1("OLAMDA=","TEXT")
      CALL UPRNT1(OLAMDA,"REAL")
      CALL UEND
      STOP
      END
      SUBROUTINE LAB(X,Y,AI,DSH,LAB1)
      M=AI
      CALL USET("DEVICE")
      CALL UMOVE(X,Y)
    1 CALL UDOIT("UP01")
      M=M-1
      IF(M.GT.0)GO TO 1
      CALL UPSET("SETDASH",DSH)
      CALL USET("DASH")
      CALL UPEN1(1.,0.,"RELATIVE")
      CALL UDOIT("SP02")
      CALL UPRNT1(LAB1,"TEXT")
      CALL USET("LINE")
      CALL UPSET("SETDASH",56.)
      CALL USET("VIRTUAL")
      RETURN
      END
```

***** SIMULATION RESULTS *****

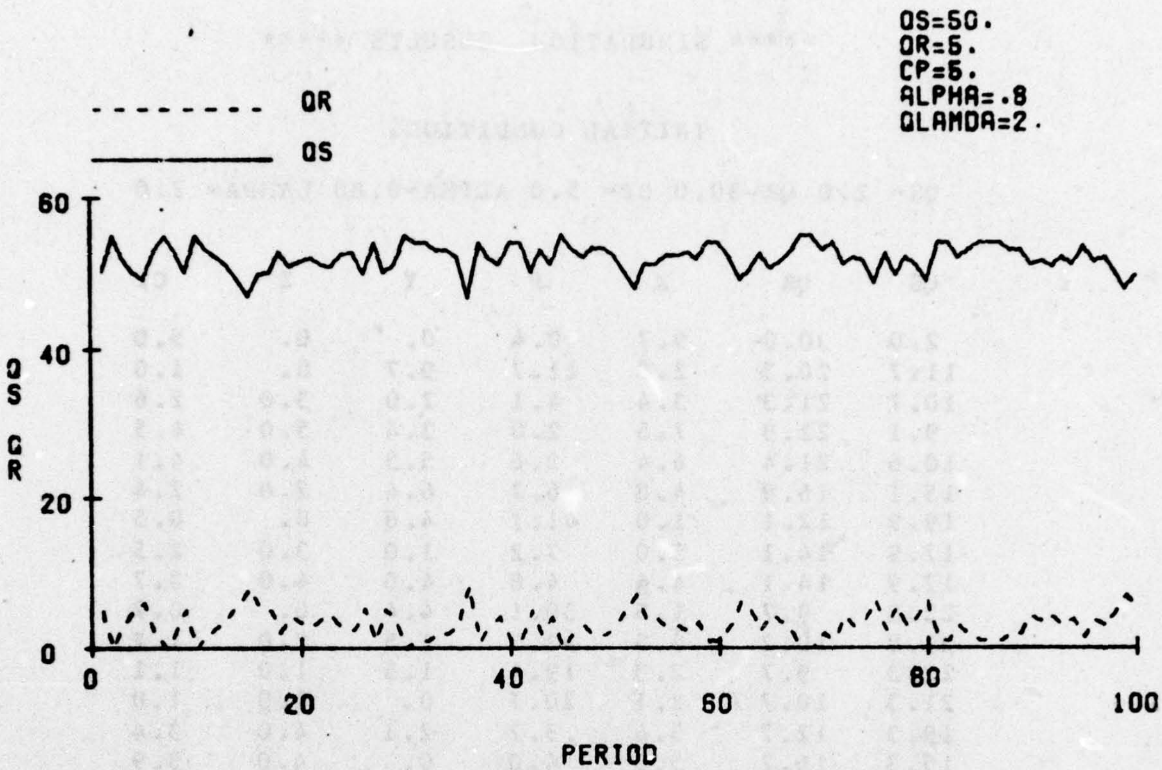
INITIAL CONDITIONS

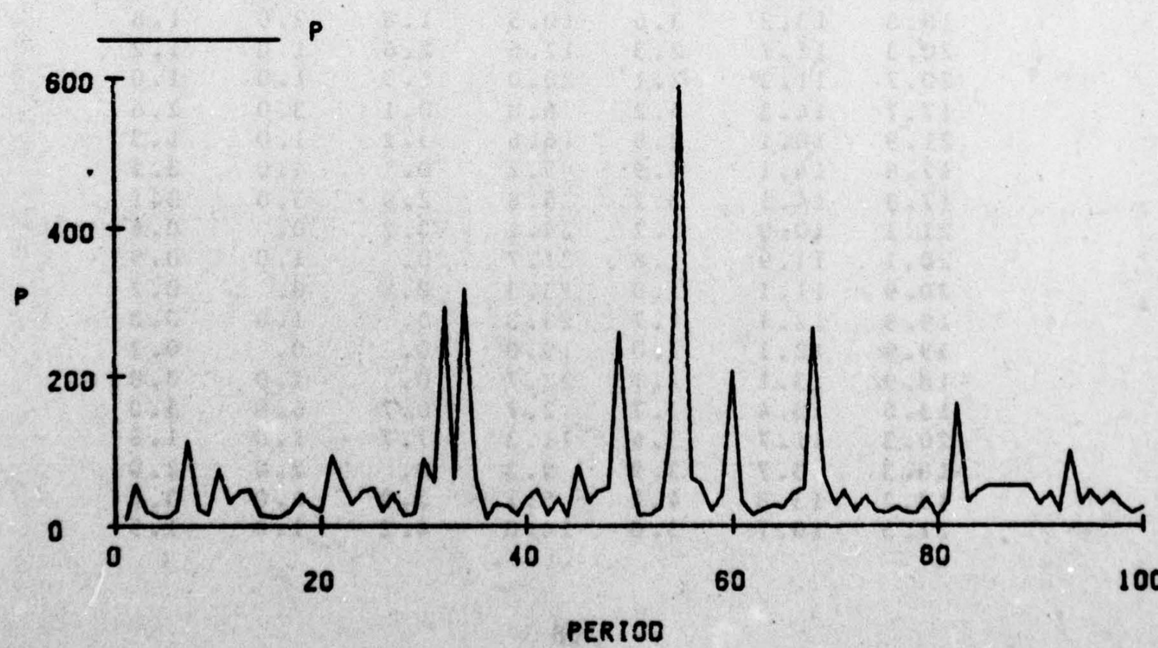
QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.80 LAMDA= 2.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
55.0	0.	0.	55.0	5.0	0.	1.0
52.0	3.0	3.0	20.0	0.	3.0	2.6
50.0	5.0	5.0	11.1	3.0	5.0	4.5
49.0	6.0	6.0	11.9	3.0	4.0	4.1
53.0	2.0	2.0	21.9	6.0	2.0	2.4
55.0	0.	1.0	13.6	2.0	0.	0.5
53.0	2.0	2.0	21.2	1.0	3.0	2.5
50.0	5.0	5.0	13.5	1.0	4.0	3.7
55.0	0.	0.	74.3	5.0	0.	0.7
53.0	2.0	2.0	30.3	0.	2.0	1.7
52.0	3.0	2.3	45.2	0.	1.0	1.1
51.0	4.0	2.1	49.5	0.	1.0	1.0
49.1	5.9	5.9	14.4	2.1	4.0	3.4
47.0	8.0	7.8	12.1	1.9	4.0	3.9
49.8	5.2	5.2	12.5	6.8	4.0	4.0
50.0	5.0	4.8	20.9	2.2	2.0	2.4
52.8	2.2	2.2	41.3	3.8	1.0	1.3
50.8	4.2	3.7	27.4	0.	2.0	1.9
51.5	3.5	3.5	18.6	3.7	3.0	2.8
52.0	3.0	1.1	93.8	0.5	0.	0.6
51.0	4.0	1.8	56.0	0.	1.0	0.9
50.8	4.2	3.6	28.5	1.8	2.0	1.8
52.4	2.6	2.3	45.3	2.6	1.0	1.2
52.7	2.3	2.1	51.1	1.3	1.0	1.0
49.8	5.2	5.2	19.1	0.1	3.0	2.6
54.0	1.0	1.0	40.9	5.2	1.0	1.3
50.0	5.0	5.0	14.4	0.	4.0	3.5
51.0	4.0	4.0	16.5	4.0	3.0	3.1
55.0	0.	0.	88.9	4.0	0.	0.6
54.0	1.0	1.0	58.5	0.	1.0	0.9
54.0	1.0	1.0	92.3	0.	0.	0.2
53.0	2.0	1.7	63.3	0.	1.0	0.8
53.0	2.0	1.0	16.6	0.	0.	0.2
52.0	3.0	1.7	62.4	0.	1.0	0.8
46.7	8.3	8.3	9.4	0.7	6.0	5.0
54.0	1.0	1.0	30.1	8.3	1.0	1.8
52.0	3.0	3.0	26.5	0.	2.0	2.0
51.0	4.0	4.0	14.2	3.0	4.0	3.6
54.0	1.0	1.0	35.6	4.0	1.0	1.5

QS	QR	X	P	Y	Z	CP
54.0	1.0	1.0	48.9	1.0	1.0	1.1
50.0	5.0	5.0	14.6	0.	4.0	3.4
53.0	2.0	2.0	35.7	4.0	1.0	1.5
51.0	4.0	4.0	14.6	2.0	4.0	3.5
55.0	0.	0.	78.6	4.0	0.	0.7
53.0	2.0	2.0	30.5	0.	2.0	1.7
52.0	3.0	2.3	45.3	0.	1.0	1.1
53.3	1.7	1.7	51.8	2.3	1.0	1.0
53.3	1.7	1.0	58.8	0.	0.	0.2
52.3	2.7	1.7	62.2	0.	1.0	0.8
50.0	5.0	5.0	14.8	1.7	4.0	3.4
48.0	7.0	6.1	15.6	1.0	3.0	3.1
51.1	3.9	3.9	23.1	5.1	2.0	2.2
51.1	3.9	1.0	15.5	0.	0.	0.4
52.1	2.9	1.0	88.6	1.0	0.	0.1
52.1	2.9	1.6	63.8	1.0	1.0	0.8
52.8	2.2	1.9	54.8	1.6	1.0	1.0
51.7	3.3	3.3	19.9	1.9	3.0	2.6
54.0	1.0	1.0	41.0	3.3	1.0	1.3
54.0	1.0	1.0	04.8	0.	0.	0.3
52.0	3.0	3.0	31.5	0.	2.0	1.7
49.0	6.0	6.0	13.9	1.0	4.0	3.5
50.0	5.0	4.6	21.7	3.0	2.0	2.3
52.6	2.4	2.4	25.5	4.6	2.0	2.1
50.6	4.4	4.0	25.2	0.	2.0	2.0
51.6	3.4	2.4	42.9	2.0	1.0	1.2
53.0	2.0	2.0	51.0	2.4	1.0	1.0
55.0	0.	1.0	64.3	2.0	0.	0.2
55.0	0.	0.	65.4	1.0	1.0	0.8
53.0	2.0	2.0	30.0	0.	2.0	1.8
54.0	1.0	1.0	46.8	2.0	1.0	1.2
51.0	4.0	4.0	19.4	0.	3.0	2.6
52.0	3.0	2.7	39.2	2.0	1.0	1.3
51.7	3.3	3.3	19.4	2.7	3.0	2.7
48.7	6.3	5.9	16.6	0.	3.0	2.9
52.5	2.5	2.5	24.0	5.9	2.0	2.2
49.5	5.5	5.5	17.5	0.	3.0	2.8
52.0	3.0	3.0	17.5	5.5	3.0	3.0
51.0	4.0	2.8	36.6	0.	1.0	1.4
48.8	6.2	6.2	11.4	2.8	5.0	4.3
54.0	1.0	1.0	32.6	6.2	1.0	1.7
54.0	1.0	1.0	63.1	0.	0.	0.3
52.0	3.0	3.0	31.2	0.	2.0	1.7
53.0	2.0	2.0	46.8	2.0	1.0	1.1
54.0	1.0	1.0	52.6	2.0	1.0	1.0
54.0	1.0	1.0	53.7	1.0	1.0	1.0
54.0	1.0	1.0	53.9	1.0	1.0	1.0
53.0	2.0	2.0	53.0	0.	1.0	1.0

QS	QR	X	P	Y	Z	CP
53.0	2.0	2.0	53.0	1.0	1.0	1.0
51.0	4.0	3.6	28.3	0.	2.0	1.8
51.6	3.4	2.3	44.5	1.6	1.0	1.2
50.9	4.1	4.1	19.3	2.3	3.0	2.6
52.0	3.0	1.1	93.8	1.1	0.	0.5
51.1	3.9	3.4	29.9	1.1	2.0	1.7
53.5	1.5	1.5	46.9	3.4	1.0	1.1
51.5	3.5	3.5	28.1	0.	2.0	1.8
52.0	3.0	2.3	44.6	1.5	1.0	1.2
50.3	4.7	3.7	27.5	0.3	2.0	1.8
48.0	7.0	5.5	17.3	0.7	3.0	2.8
49.5	5.5	4.3	23.0	3.5	2.0	2.2


QS=50.
QR=5.
CP=5.
ALPHA=.8
QLAMDA=2.
QR
QS
60
40
20
0
QS
QR
0
20
40
60
80
100
PERIOD


P
600
400
200
0
P
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

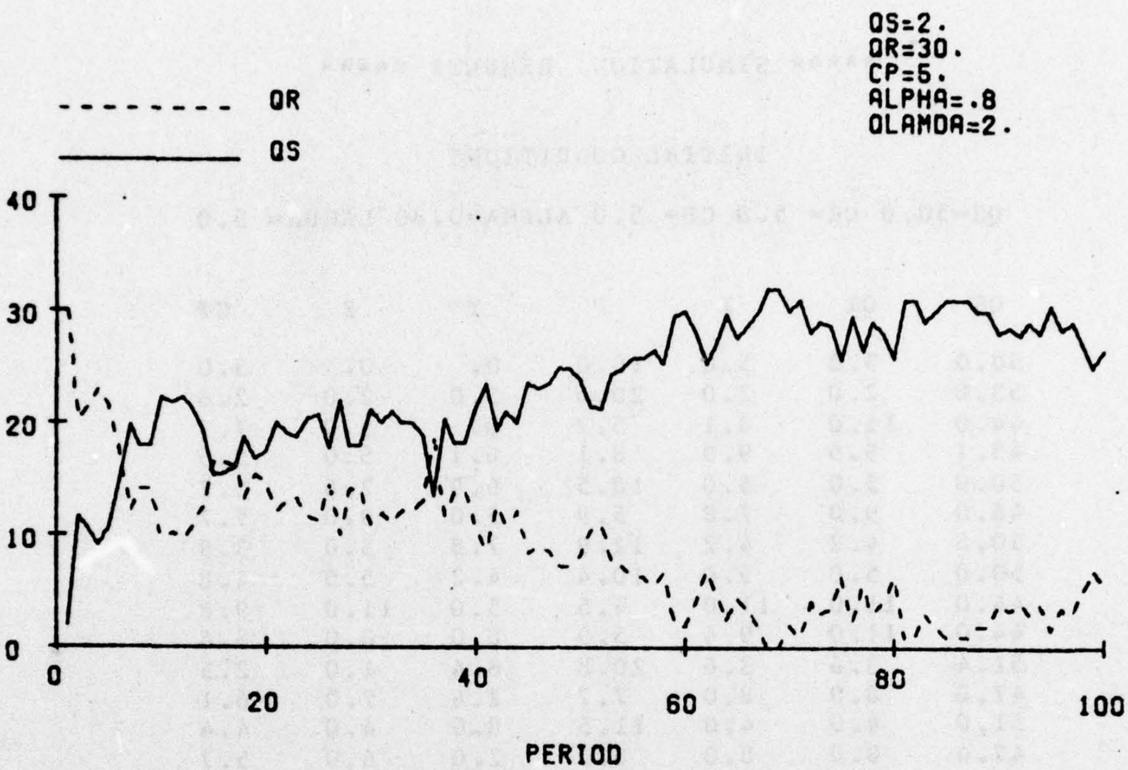
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.80 LAMDA= 2.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
11.7	20.3	2.0	11.7	9.7	0.	1.0
10.7	21.3	3.4	4.1	2.0	3.0	2.6
9.1	22.9	7.5	2.0	3.4	5.0	4.5
10.6	21.4	6.4	2.6	5.5	4.0	4.1
15.1	16.9	4.8	6.2	6.4	2.0	2.4
19.9	12.1	1.0	41.1	4.8	0.	0.5
17.9	14.1	5.0	7.2	1.0	3.0	2.5
17.9	14.1	4.4	4.8	4.0	4.0	3.7
22.3	9.7	1.5	30.1	4.4	0.	0.7
21.8	10.2	3.5	12.5	1.5	2.0	1.7
22.3	9.7	2.3	19.4	1.5	1.0	1.1
21.3	10.7	2.1	20.7	0.	1.0	1.0
19.3	12.7	3.6	5.7	2.1	4.0	3.4
15.3	16.7	5.2	4.0	0.	4.0	3.9
15.5	16.5	5.4	3.9	4.2	4.0	4.0
15.9	16.1	4.8	6.6	2.4	2.0	2.4
18.7	13.3	2.6	14.6	3.8	1.0	1.3
16.7	15.3	3.7	9.0	0.	2.0	1.9
17.4	14.6	5.5	6.3	3.7	3.0	2.8
20.0	12.0	1.1	36.0	2.5	0.	0.6
19.0	13.0	1.8	20.8	0.	1.0	0.9
18.8	13.2	3.6	10.5	1.8	2.0	1.8
20.3	11.7	2.3	17.6	2.6	1.0	1.2
20.7	11.3	2.1	20.0	1.3	1.0	1.0
17.7	14.3	5.2	6.8	0.1	3.0	2.6
21.9	10.1	2.6	16.6	5.2	1.0	1.3
17.9	14.1	3.9	5.2	0.	4.0	3.5
17.9	14.1	3.2	5.8	2.9	3.0	3.1
21.1	10.9	1.2	34.1	3.2	0.	0.6
20.1	11.9	1.8	21.7	0.	1.0	0.9
20.9	11.1	1.0	13.3	0.8	0.	0.2
19.9	12.1	1.7	23.8	0.	1.0	0.8
19.9	12.1	1.0	19.0	0.	0.	0.2
18.9	13.1	1.7	22.7	0.	1.0	0.8
13.6	18.4	7.7	2.7	0.7	6.0	5.0
20.3	11.7	3.6	11.3	7.7	1.0	1.8
18.3	13.7	3.9	9.3	0.	2.0	2.0
18.2	13.8	4.2	5.1	3.9	4.0	3.6
21.3	10.7	3.0	14.0	4.2	1.0	1.5

QS	QR	X	P	Y	Z	CP
23.4	8.6	2.2	21.2	3.0	1.0	1.1
19.4	12.6	3.6	5.7	0.	4.0	3.4
21.0	11.0	3.0	14.1	2.6	1.0	1.5
19.9	12.1	3.7	5.7	3.0	4.0	3.5
23.6	8.4	1.4	33.8	3.7	0.	0.7
23.0	9.0	3.5	13.2	1.4	2.0	1.7
23.5	8.5	2.3	20.5	1.5	1.0	1.1
24.8	7.2	2.1	24.1	2.3	1.0	1.0
24.8	7.2	1.0	20.4	0.	0.	0.2
23.8	8.2	1.7	28.3	0.	1.0	0.8
21.5	10.5	6.7	6.4	1.7	4.0	3.4
21.2	10.8	6.1	6.9	2.7	3.0	3.1
24.4	7.6	4.4	11.0	5.1	2.0	2.2
24.8	7.2	1.0	56.0	0.4	0.	0.4
25.8	6.2	1.0	91.1	1.0	0.	0.1
25.8	6.2	1.6	31.5	1.0	1.0	0.8
26.4	5.6	1.9	27.4	1.6	1.0	1.0
25.3	6.7	5.2	9.8	1.9	3.0	2.6
29.5	2.5	2.5	22.4	5.2	1.0	1.3
30.0	2.0	1.0	13.8	0.5	0.	0.3
28.0	4.0	3.3	16.9	0.	2.0	1.7
25.3	6.7	6.7	7.2	1.3	4.0	3.5
27.0	5.0	4.6	11.7	3.7	2.0	2.3
29.6	2.4	2.4	14.4	4.6	2.0	2.1
27.6	4.4	4.0	13.7	0.	2.0	2.0
28.6	3.4	2.4	23.8	2.0	1.0	1.2
30.0	2.0	2.0	28.9	2.4	1.0	1.0
32.0	0.	1.0	53.8	2.0	0.	0.2
32.0	0.	0.	38.0	1.0	1.0	0.8
30.0	2.0	2.0	17.0	0.	2.0	1.8
31.0	1.0	1.0	26.9	2.0	1.0	1.2
28.0	4.0	4.0	10.6	0.	3.0	2.6
29.0	3.0	2.7	21.9	2.0	1.0	1.3
28.7	3.3	3.3	10.8	2.7	3.0	2.7
25.7	6.3	5.9	8.7	0.	3.0	2.9
29.5	2.5	2.5	13.5	5.9	2.0	2.2
26.5	5.5	5.5	9.3	0.	3.0	2.8
29.0	3.0	3.0	9.8	5.5	3.0	3.0
28.0	4.0	2.8	20.1	0.	1.0	1.4
25.8	6.2	6.2	6.0	2.8	5.0	4.3
31.0	1.0	1.0	18.7	6.2	1.0	1.7
31.0	1.0	1.0	93.6	0.	0.	0.3
29.0	3.0	3.0	17.4	0.	2.0	1.7
30.0	2.0	2.0	26.5	2.0	1.0	1.1
31.0	1.0	1.0	30.2	2.0	1.0	1.0
31.0	1.0	1.0	30.8	1.0	1.0	1.0
31.0	1.0	1.0	31.0	1.0	1.0	1.0
30.0	2.0	2.0	30.0	0.	1.0	1.0

QS	QR	X	P	Y	Z	CP
30.0	2.0	2.0	30.0	1.0	1.0	1.0
28.0	4.0	3.6	15.6	0.	2.0	1.8
28.6	3.4	2.3	24.7	1.6	1.0	1.2
27.9	4.1	4.1	10.6	2.3	3.0	2.6
29.0	3.0	1.1	55.1	1.1	0.	0.5
28.1	3.9	3.4	16.5	1.1	2.0	1.7
30.5	1.5	1.5	26.7	3.4	1.0	1.1
28.5	3.5	3.5	15.6	0.	2.0	1.8
29.0	3.0	2.3	24.9	1.5	1.0	1.2
27.3	4.7	3.7	14.9	0.3	2.0	1.8
25.0	7.0	5.5	9.0	0.7	3.0	2.8
26.5	5.5	4.3	12.3	3.5	2.0	2.2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QR=30.
CP=5.
ALPHA=.8
OLAMDA=2.
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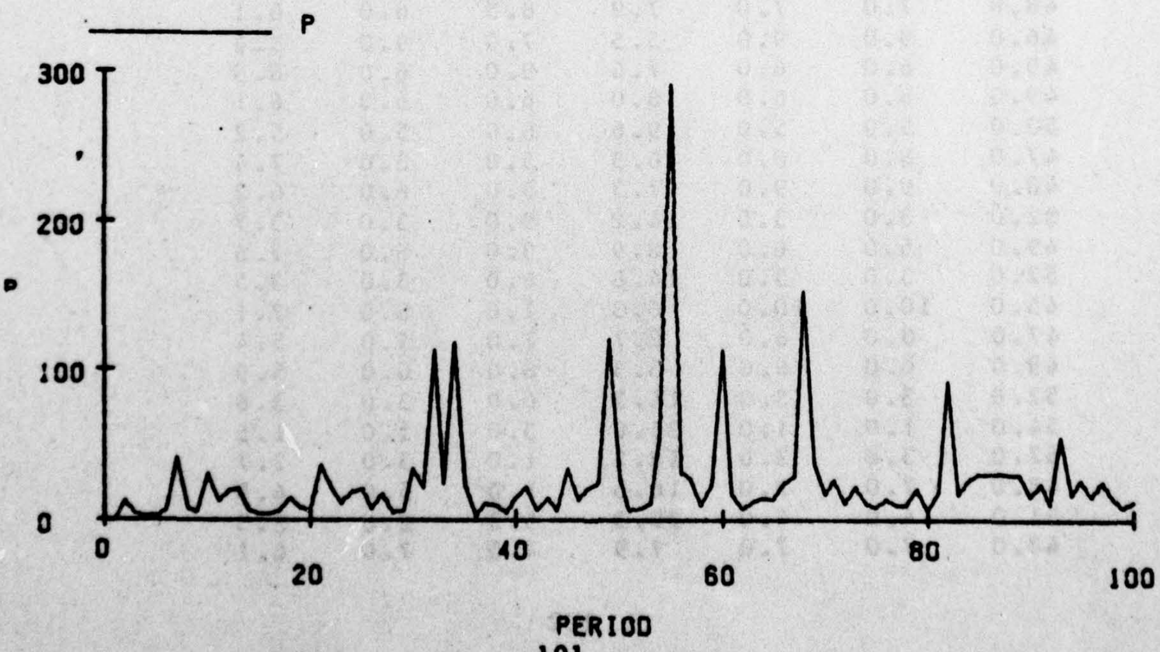
QS
QS
QR
0
10
20
30
40
0
20
40
60
80
100
PERIOD


P
P
0
100
200
300
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

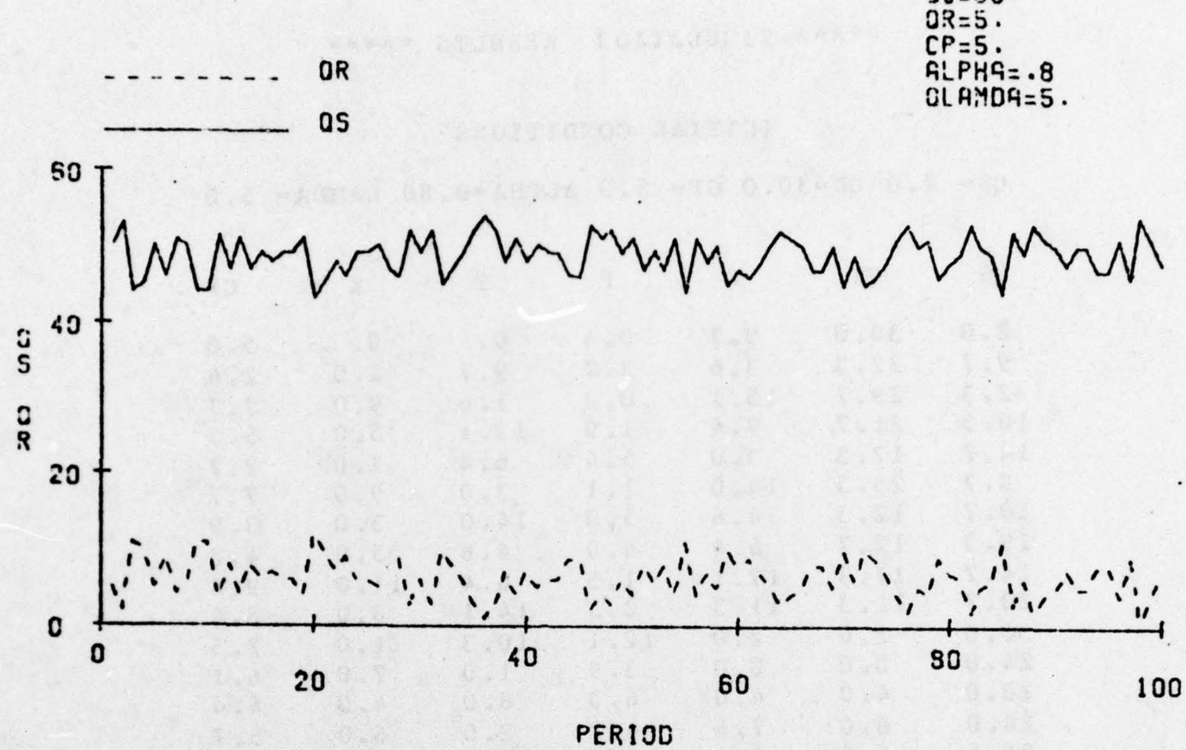
INITIAL CONDITIONS

QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.80 LAMDA= 5.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
53.0	2.0	2.0	20.4	5.0	2.0	2.6
44.0	11.0	8.1	5.7	0.	9.0	7.7
45.1	9.9	9.9	8.1	6.1	5.0	5.5
50.0	5.0	5.0	13.5	6.9	2.0	2.7
46.0	9.0	7.8	5.9	5.0	9.0	7.7
50.8	4.2	4.2	12.9	7.8	3.0	3.9
50.0	5.0	5.0	10.4	4.2	5.0	4.8
44.0	11.0	11.0	4.5	5.0	11.0	9.8
44.0	11.0	9.4	5.3	8.0	3.0	8.4
51.4	3.6	3.6	20.8	8.4	1.0	2.5
47.0	8.0	8.0	7.7	2.6	7.0	6.1
51.0	4.0	4.0	11.5	8.0	4.0	4.4
47.0	8.0	8.0	8.3	2.0	6.0	5.7
49.0	6.0	6.0	11.3	6.0	4.0	4.3
48.0	7.0	7.0	8.5	5.0	6.0	5.7
49.0	6.0	6.0	9.5	6.0	5.0	5.1
49.0	6.0	6.0	14.3	3.0	3.0	3.4
51.0	4.0	4.0	16.5	5.0	3.0	3.1
43.0	12.0	8.5	5.5	1.0	9.0	7.8
45.5	9.5	9.5	7.1	8.5	6.0	6.4
48.0	7.0	7.0	7.9	8.5	6.0	6.1
46.0	9.0	9.0	5.5	7.0	9.0	8.4
49.0	6.0	6.0	7.6	9.0	6.0	6.5
49.0	6.0	6.0	8.0	6.0	6.0	6.1
50.0	5.0	5.0	9.6	6.0	5.0	5.2
47.0	8.0	8.0	6.3	5.0	8.0	7.4
46.0	9.0	9.0	7.3	5.0	6.0	6.3
52.0	3.0	3.0	14.2	9.0	3.0	3.7
49.0	6.0	6.0	8.9	3.0	6.0	5.5
52.0	3.0	3.0	14.8	6.0	3.0	3.5
45.0	10.0	10.0	6.3	1.0	8.0	7.1
47.0	8.0	8.0	8.7	7.0	5.0	5.4
49.0	6.0	6.0	8.3	8.0	6.0	5.9
52.0	3.0	3.0	14.5	6.0	3.0	3.6
54.0	1.0	1.0	35.6	3.0	1.0	1.5
52.0	3.0	3.0	19.2	1.0	3.0	2.7
48.0	7.0	7.0	10.6	1.0	5.0	4.5
51.0	4.0	4.0	20.3	5.0	2.0	2.5
48.0	7.0	7.0	7.9	4.0	7.0	6.1

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	9.6	7.0	5.0	5.2
49.0	6.0	6.0	9.7	4.0	5.0	5.0
49.0	6.0	5.2	18.8	2.0	2.0	2.6
46.2	8.8	8.8	7.5	4.2	7.0	6.1
46.0	9.0	8.8	10.4	3.8	4.0	4.4
52.8	2.2	2.2	31.4	7.8	1.0	1.7
51.0	4.0	4.0	14.4	2.2	4.0	3.5
52.0	3.0	3.0	16.7	4.0	3.0	3.1
49.0	6.0	6.0	9.0	3.0	6.0	5.4
51.0	4.0	4.0	19.0	4.0	2.0	2.7
47.0	8.0	7.5	12.6	0.	4.0	3.7
49.5	5.5	5.5	10.4	7.5	5.0	4.7
47.0	8.0	8.0	9.5	2.5	5.0	4.9
51.0	4.0	4.0	19.7	6.0	2.0	2.6
44.0	11.0	11.0	6.4	1.0	8.0	6.9
51.0	4.0	4.0	23.4	8.0	1.0	2.2
48.0	7.0	7.0	8.0	4.0	7.0	6.0
50.0	5.0	5.0	9.6	7.0	5.0	5.2
45.0	10.0	9.0	5.5	4.0	9.0	8.2
47.0	8.0	8.0	6.5	9.0	7.0	7.2
46.0	9.0	9.0	6.5	6.0	7.0	7.0
48.0	7.0	7.0	8.9	7.0	5.0	5.4
50.0	5.0	5.0	9.8	7.0	5.0	5.1
52.0	3.0	3.0	15.2	5.0	3.0	3.4
51.0	4.0	4.0	13.1	3.0	4.0	3.9
50.0	5.0	5.0	12.6	3.0	4.0	4.0
47.0	8.0	8.0	11.8	1.0	4.0	4.0
47.0	8.0	8.0	11.8	4.0	4.0	4.0
50.0	5.0	5.0	10.4	8.0	5.0	4.8
45.0	10.0	9.9	9.1	0.	5.0	5.0
48.9	6.1	6.1	8.4	9.9	6.0	5.8
45.0	10.0	10.0	6.7	3.1	7.0	6.8
46.0	9.0	9.0	5.4	10.0	9.0	8.6
48.0	7.0	7.0	9.8	6.0	4.0	4.9
51.0	4.0	4.0	15.1	6.0	3.0	3.4
53.0	2.0	2.0	23.3	4.0	2.0	2.3
50.0	5.0	5.0	11.2	2.0	5.0	4.5
51.0	4.0	4.0	15.5	4.0	3.0	3.3
46.0	9.0	9.0	8.4	1.0	6.0	5.5
48.0	7.0	7.0	7.2	9.0	7.0	6.7
49.0	6.0	6.0	9.2	6.0	5.0	5.3
53.0	2.0	2.0	19.9	6.0	2.0	2.7
50.0	5.0	5.0	13.4	1.0	4.0	3.7
49.0	6.0	6.0	8.8	5.0	6.0	5.5
44.0	11.0	11.0	7.4	1.0	6.0	5.9
52.0	3.0	3.0	14.5	11.0	3.0	3.6
49.0	6.0	6.0	15.7	0.	3.0	3.1
53.0	2.0	2.0	37.2	5.0	1.0	1.4

QS	QR	X	P	Y	Z	CP
51.0	4.0	4.0	14.6	2.0	4.0	3.5
50.0	5.0	4.6	21.8	1.0	2.0	2.3
47.6	7.4	7.4	10.7	2.6	5.0	4.5
50.0	5.0	5.0	15.2	5.4	3.0	3.3
50.0	5.0	5.0	13.0	4.0	4.0	3.9
47.0	8.0	8.0	7.4	4.0	7.0	6.4
47.0	8.0	8.0	7.7	6.0	6.0	6.1
51.0	4.0	4.0	11.6	8.0	4.0	4.4
46.0	9.0	9.0	8.1	1.0	6.0	5.7
54.0	1.0	1.0	27.9	9.0	1.0	1.9
51.0	4.0	4.0	14.2	1.0	4.0	3.6
43.0	7.0	7.0	8.7	3.0	6.0	5.5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QR=5.
CP=5.
ALPHA=.8
QLAMDA=5.
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QS
QS QR
PERIOD
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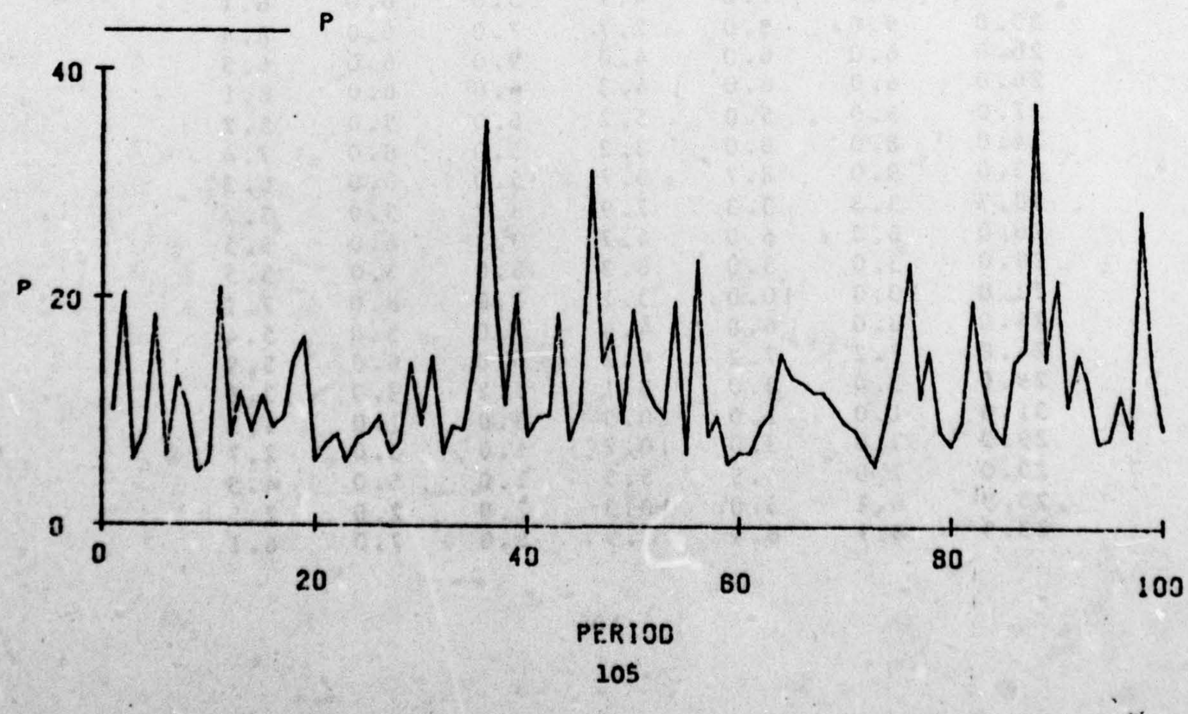
20
40
60
80
100


P
PERIOD
0
20
40
60
80
100

***** SIMULATION RESULTS *****

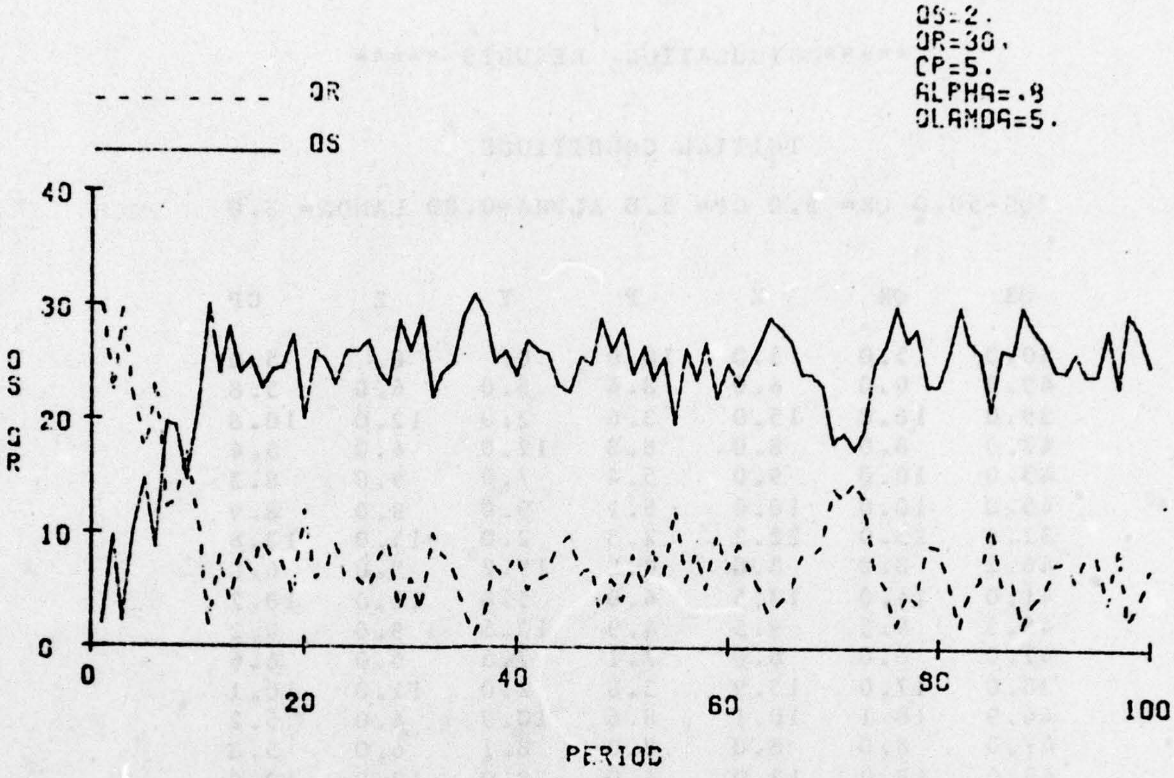
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.80 LAMDA= 5.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
9.7	22.3	3.6	3.7	9.7	2.0	2.6
2.3	29.7	15.1	0.3	1.6	9.0	7.7
10.3	21.7	9.4	1.9	13.1	5.0	5.5
14.7	17.3	3.0	5.4	6.4	2.0	2.7
8.7	23.3	14.0	1.1	3.0	9.0	7.7
19.7	12.3	4.6	5.0	14.0	3.0	3.9
19.3	12.7	6.4	4.0	4.6	5.0	4.8
14.7	17.3	17.1	1.5	6.4	11.0	9.8
20.7	11.3	11.3	2.5	14.1	8.0	8.4
30.0	2.0	2.0	12.1	10.3	1.0	2.5
24.0	8.0	8.0	3.9	1.0	7.0	6.1
28.0	4.0	4.0	6.3	8.0	4.0	4.4
24.0	8.0	7.4	4.2	2.0	6.0	5.7
25.4	6.6	4.4	5.8	5.4	4.0	4.3
22.8	9.2	7.5	4.0	3.4	6.0	5.7
24.3	7.7	6.2	4.7	6.5	5.0	5.1
24.6	7.4	6.9	7.2	3.2	3.0	3.4
27.4	4.6	4.6	8.9	5.9	3.0	3.1
20.0	12.0	12.0	2.6	1.6	9.0	7.8
26.0	6.0	6.0	4.1	12.0	6.0	6.4
25.0	7.0	7.0	4.1	5.0	6.0	6.1
23.0	9.0	9.0	2.7	7.0	9.0	8.4
26.0	6.0	6.0	4.0	9.0	6.0	6.5
26.0	6.0	6.0	4.3	6.0	6.0	6.1
27.0	5.0	5.0	5.2	6.0	5.0	5.2
24.0	8.0	8.0	3.2	5.0	8.0	7.4
23.0	9.0	8.7	3.7	5.0	6.0	6.3
28.7	3.3	3.3	7.9	8.7	3.0	3.7
26.0	6.0	6.0	4.7	3.3	6.0	5.5
29.0	3.0	3.0	8.3	6.0	3.0	3.5
22.0	10.0	10.0	3.1	1.0	8.0	7.1
24.0	8.0	6.8	4.4	7.0	5.0	5.4
24.8	7.2	7.2	4.2	6.8	6.0	5.9
29.0	3.0	3.0	8.1	7.2	3.0	3.6
31.0	1.0	1.0	20.5	3.0	1.0	1.5
29.0	3.0	3.0	10.7	1.0	3.0	2.7
25.0	7.0	4.9	5.5	1.0	5.0	4.5
25.9	6.1	5.0	10.3	2.9	2.0	2.5
23.9	8.1	8.1	3.9	5.0	7.0	6.1

QS	QR	X	P	Y	Z	CP
27.0	5.0	5.0	5.2	8.1	5.0	5.2
26.0	6.0	5.8	5.2	4.0	5.0	5.0
25.8	6.2	5.2	9.9	1.8	2.0	2.6
23.0	9.0	8.4	3.8	4.2	7.0	6.1
22.4	9.6	5.1	5.1	3.4	4.0	4.4
25.5	6.5	3.4	15.1	4.1	1.0	1.7
24.9	7.1	7.1	7.0	3.4	4.0	3.5
28.9	3.1	3.1	9.3	7.1	3.0	3.1
26.0	6.0	6.0	4.8	3.1	6.0	5.4
28.0	4.0	4.0	10.4	4.0	2.0	2.7
24.0	8.0	7.5	6.4	0.	4.0	3.7
26.5	5.5	5.1	5.6	7.5	5.0	4.7
23.6	8.4	6.0	4.8	2.1	5.0	4.9
25.5	6.5	5.2	9.9	4.0	2.0	2.6
19.7	12.3	10.6	2.8	2.2	8.0	6.9
26.3	5.7	4.4	12.0	7.6	1.0	2.2
23.6	8.4	8.1	3.9	4.4	7.0	6.0
26.8	5.2	5.2	5.1	8.1	5.0	5.2
22.0	10.0	10.0	2.7	4.2	9.0	8.2
25.0	7.0	7.0	3.4	10.0	7.0	7.2
23.0	9.0	9.0	3.3	5.0	7.0	7.0
25.0	7.0	6.7	4.6	7.0	5.0	5.4
26.7	5.3	5.3	5.2	6.7	5.0	5.1
29.0	3.0	3.0	8.5	5.3	3.0	3.4
28.0	4.0	4.0	7.2	3.0	4.0	3.9
27.0	5.0	5.0	6.8	3.0	4.0	4.0
24.0	8.0	8.0	6.0	1.0	4.0	4.0
24.0	8.0	4.0	6.0	4.0	4.0	4.0
23.0	9.0	5.8	4.8	4.0	5.0	4.8
18.0	14.0	6.9	3.6	0.	5.0	5.0
18.9	13.1	8.4	3.3	6.9	6.0	5.8
17.3	14.7	10.6	2.6	5.4	7.0	6.8
19.0	13.0	13.0	2.2	10.6	9.0	8.6
25.0	7.0	5.7	5.1	10.0	4.0	4.9
26.7	5.3	5.3	7.9	4.7	3.0	3.4
30.0	2.0	2.0	13.2	5.3	2.0	2.3
27.0	5.0	5.0	6.1	2.0	5.0	4.5
28.0	4.0	4.0	8.5	4.0	3.0	3.3
23.0	9.0	7.1	4.2	1.0	6.0	5.5
23.1	8.9	8.9	3.4	7.1	7.0	6.7
26.0	6.0	6.0	4.9	7.9	5.0	5.3
30.0	2.0	2.0	11.2	6.0	2.0	2.7
27.0	5.0	5.0	7.2	1.0	4.0	3.7
26.0	6.0	6.0	4.7	5.0	6.0	5.5
21.0	11.0	8.3	3.6	1.0	6.0	5.9
26.3	5.7	5.7	7.3	8.3	3.0	3.6
26.0	6.0	6.0	8.3	2.7	3.0	3.1
30.0	2.0	2.0	21.1	5.0	1.0	1.4

QS	QR	X	P	Y	Z	CP
28.0	4.0	4.0	8.0	2.0	4.0	3.5
27.0	5.0	4.6	11.8	1.0	2.0	2.3
24.6	7.4	4.8	5.5	2.6	5.0	4.5
24.4	7.6	6.6	7.4	2.8	3.0	3.3
26.0	6.0	6.0	6.7	5.6	4.0	3.9
24.0	8.0	8.0	3.8	5.0	7.0	6.4
24.0	8.0	8.0	4.0	6.0	6.0	6.1
28.0	4.0	4.0	6.3	8.0	4.0	4.4
23.0	9.0	7.5	4.0	1.0	6.0	5.7
29.5	2.5	2.5	15.2	7.5	1.0	1.9
28.0	4.0	4.0	7.8	2.5	4.0	3.6
25.0	7.0	6.9	4.5	3.0	6.0	5.5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CP=5.
ALPHA=.8
OLAMDA=5.
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10
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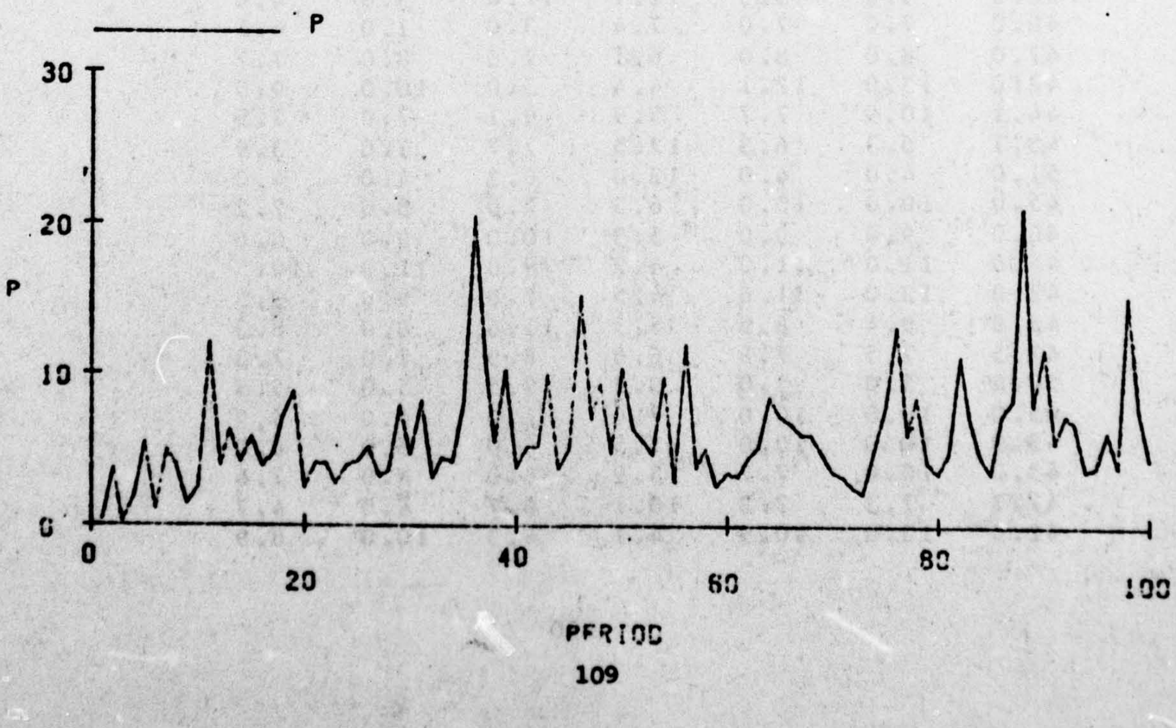
OS
OR
0
20
40
60
80
100
PERIOD


P
30
20
10
0
P
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

INITIAL CONDITIONS

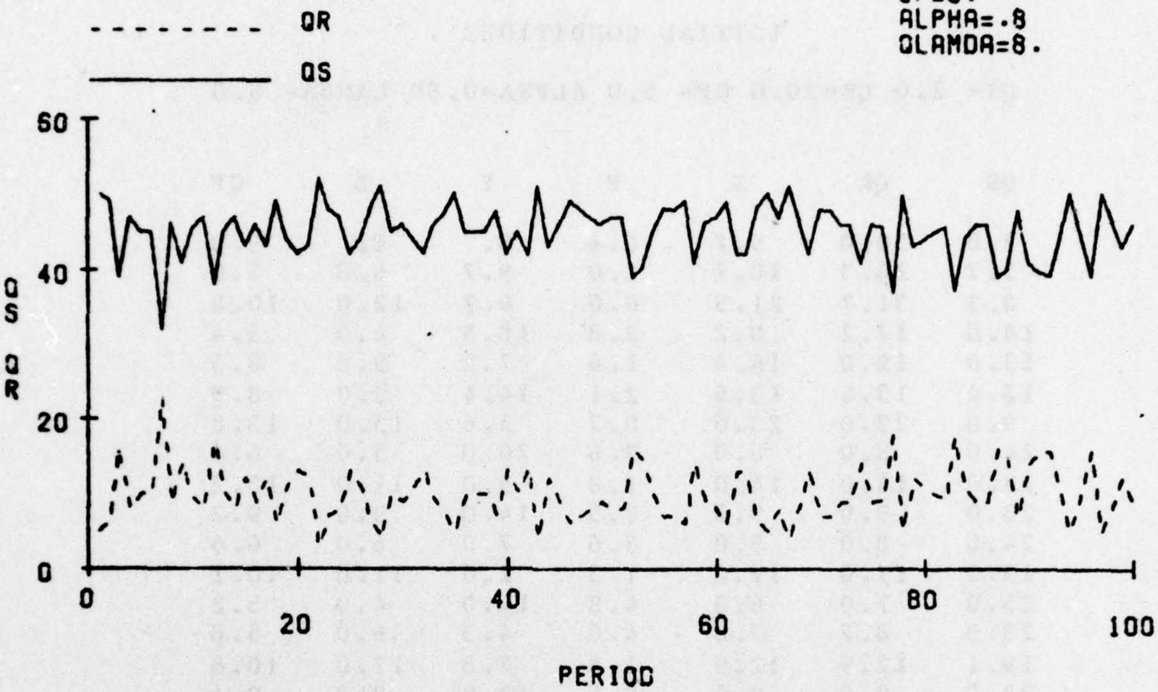
QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.80 LAMDA= 8.0

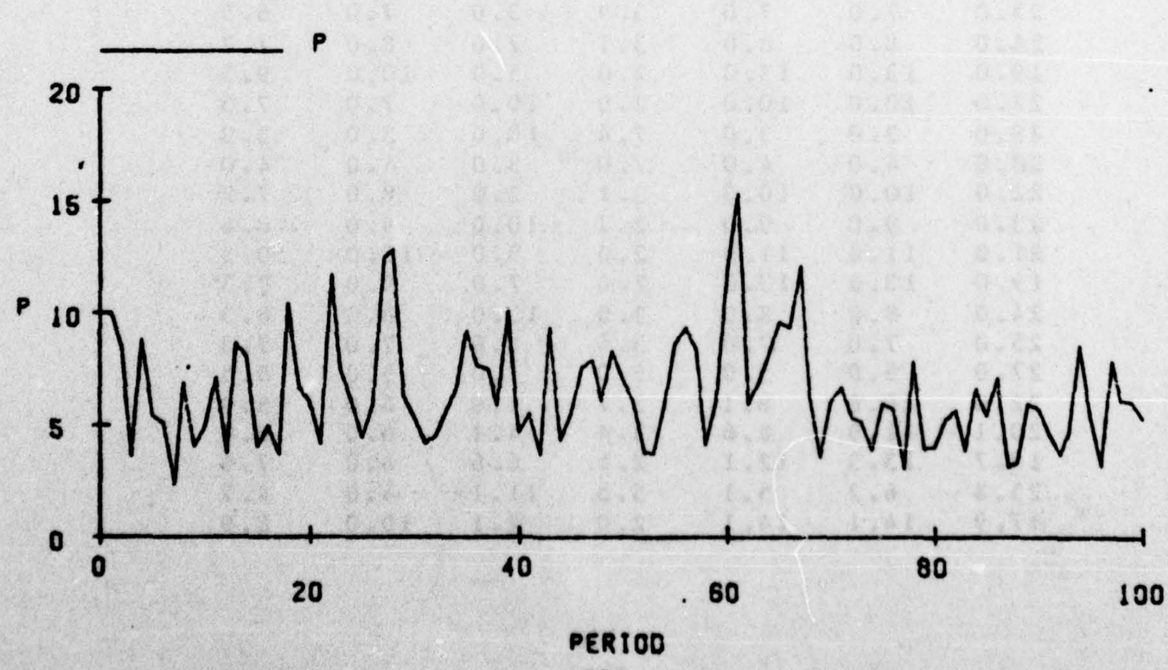
QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
49.0	6.0	6.0	8.4	5.0	6.0	5.8
39.0	16.0	15.0	3.6	2.0	12.0	10.8
47.0	8.0	8.0	8.8	12.0	4.0	5.4
45.0	10.0	9.0	5.4	7.0	9.0	8.3
45.0	10.0	10.0	5.1	9.0	9.0	8.9
32.0	23.0	22.2	2.3	2.0	15.0	13.8
46.2	8.8	8.8	6.8	19.2	5.0	6.8
41.0	14.0	13.5	4.0	5.8	11.0	10.2
45.5	9.5	9.5	4.9	13.5	9.0	9.2
47.0	8.0	8.0	7.1	7.5	6.0	6.6
38.0	17.0	13.9	3.8	2.0	11.0	10.1
44.9	10.1	10.1	8.6	10.9	4.0	5.2
47.0	8.0	8.0	8.0	8.1	6.0	5.8
43.0	12.0	12.0	4.0	8.0	12.0	10.8
46.0	9.0	9.0	4.9	12.0	9.0	9.4
43.0	12.0	12.0	3.7	9.0	12.0	11.5
49.0	6.0	6.0	10.4	9.0	3.0	4.7
44.0	11.0	11.0	6.7	2.0	7.0	6.5
42.0	13.0	13.0	6.1	5.0	7.0	6.9
43.0	12.0	12.0	4.2	12.0	11.0	10.2
52.0	3.0	3.0	11.7	12.0	3.0	4.4
48.0	7.0	7.0	7.4	3.0	7.0	6.5
47.0	8.0	8.0	6.1	7.0	8.0	7.7
42.0	13.0	12.1	4.4	5.0	10.0	9.5
44.1	10.9	7.7	5.9	9.1	7.0	7.5
48.7	6.3	6.3	12.5	7.7	3.0	3.9
51.0	4.0	4.0	12.8	6.3	4.0	4.0
45.0	10.0	10.0	6.3	2.0	8.0	7.2
46.0	9.0	9.0	5.3	10.0	9.0	8.6
44.0	11.0	11.0	4.2	9.0	11.0	10.5
42.0	13.0	11.6	4.5	7.0	9.0	9.3
45.6	9.4	8.9	5.5	11.6	8.0	8.3
47.5	7.5	7.5	6.6	8.9	7.0	7.3
50.0	5.0	5.0	9.2	7.5	5.0	5.5
45.0	10.0	10.0	7.6	1.0	6.0	5.9
45.0	10.0	10.0	7.5	6.0	6.0	6.0
45.0	10.0	7.7	5.9	8.0	8.0	7.6
47.7	7.3	7.3	10.1	6.7	4.0	4.7
42.0	13.0	10.9	4.7	4.3	10.0	8.9

QS	QR	X	P	Y	Z	CP
44.9	10.1	8.9	5.5	10.9	8.0	8.2
41.8	13.2	13.2	3.7	8.9	12.0	11.2
51.0	4.0	4.0	9.4	13.2	4.0	5.4
43.0	12.0	12.0	4.3	3.0	11.0	9.9
46.0	9.0	9.0	5.5	11.0	8.0	8.4
49.0	6.0	6.0	7.6	9.0	6.0	6.5
48.0	7.0	7.0	7.9	5.0	6.0	6.1
47.0	8.0	8.0	6.2	7.0	8.0	7.6
46.0	9.0	9.0	8.3	4.0	5.0	5.5
47.0	8.0	8.0	7.0	8.0	7.0	6.7
47.0	8.0	8.0	6.1	8.0	8.0	7.7
39.0	16.0	14.2	3.8	3.0	11.0	10.3
40.2	14.8	14.8	3.7	12.2	11.0	10.9
45.0	10.0	8.0	5.8	11.8	7.0	7.8
48.0	7.0	7.0	8.6	8.0	5.0	5.6
48.0	7.0	7.0	9.4	5.0	5.0	5.1
49.0	6.0	6.0	8.4	7.0	6.0	5.8
41.0	14.0	13.1	4.1	3.0	11.0	10.0
46.1	8.9	8.9	6.1	12.1	7.0	7.6
47.0	8.0	7.8	12.0	3.9	3.0	3.9
48.8	6.2	6.2	15.3	4.8	3.0	3.2
42.0	13.0	7.1	6.0	1.2	8.0	7.0
42.1	12.9	12.4	6.8	6.1	6.0	6.2
48.5	6.5	6.5	8.0	12.4	6.0	6.0
50.0	5.0	5.0	9.6	6.5	5.0	5.2
47.0	8.0	8.0	9.3	2.0	5.0	5.0
51.0	4.0	4.0	12.1	8.0	4.0	4.2
47.0	8.0	8.0	6.5	4.0	8.0	7.2
42.0	13.0	13.0	3.5	8.0	13.0	11.8
48.0	7.0	7.0	6.0	13.0	7.0	8.0
48.0	7.0	7.0	6.7	7.0	7.0	7.2
46.0	9.0	9.0	5.3	7.0	9.0	8.6
46.0	9.0	9.0	5.2	9.0	9.0	8.9
41.0	14.0	14.0	3.9	6.0	11.0	10.6
46.0	9.0	7.8	6.0	12.0	7.0	7.7
45.8	9.2	8.3	5.8	7.8	8.0	7.9
37.0	18.0	17.8	3.1	4.3	13.0	12.0
49.8	5.2	5.2	7.8	17.8	5.0	6.4
43.0	12.0	12.0	4.0	5.2	12.0	10.9
44.0	11.0	11.0	4.0	12.0	11.0	11.0
45.0	10.0	9.7	5.2	9.0	8.0	8.6
45.7	9.3	8.6	5.6	8.7	8.0	8.1
37.3	17.7	13.0	3.9	1.6	10.0	9.6
44.3	10.7	10.7	6.6	13.0	6.0	6.7
46.0	9.0	9.0	5.4	10.7	9.0	3.5
46.0	9.0	9.0	7.1	6.0	6.0	6.5
39.0	16.0	16.0	3.1	7.0	14.0	12.5
40.0	15.0	15.0	3.3	13.0	12.0	12.1

QS	QR	X	P	Y	Z	CP
48.0	7.0	7.0	6.0	15.0	7.0	8.0
41.0	14.0	7.6	5.7	0.	7.0	7.2
39.6	15.4	10.7	4.6	7.6	9.0	8.6
39.3	15.7	14.5	3.7	10.7	11.0	10.5
43.8	11.2	11.2	4.7	13.5	9.0	9.3
50.0	5.0	5.0	8.5	11.2	5.0	5.9
45.0	10.0	9.2	5.4	4.0	9.0	8.4
39.2	15.8	15.8	3.3	7.2	13.0	12.1
50.0	5.0	5.0	7.8	15.8	5.0	6.4
47.0	8.0	8.0	6.1	5.0	8.0	7.7
43.0	12.0	12.0	6.0	3.0	7.0	7.1
46.0	9.0	9.0	5.3	12.0	9.0	8.6

QS=50.
QR=5.
CP=5.
ALPHA=.8
QLAMDA=8.





***** SIMULATION RESULTS *****

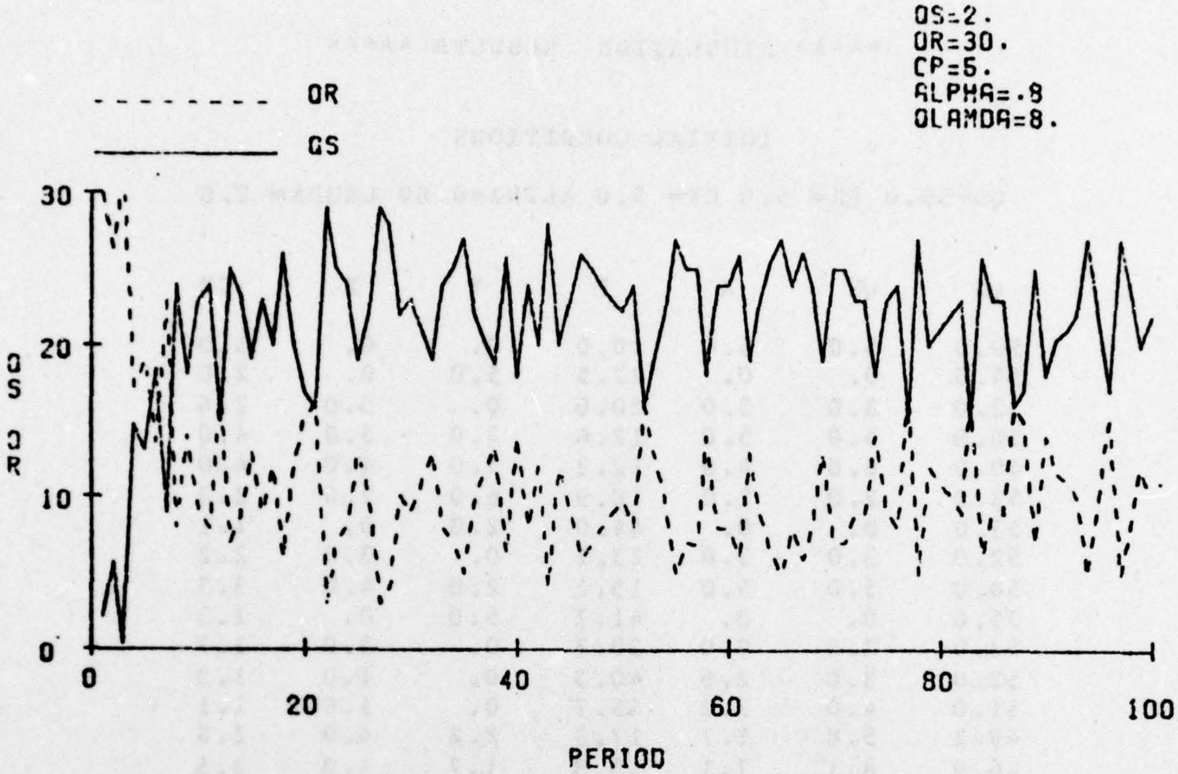
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.80 LANDA= 8.0

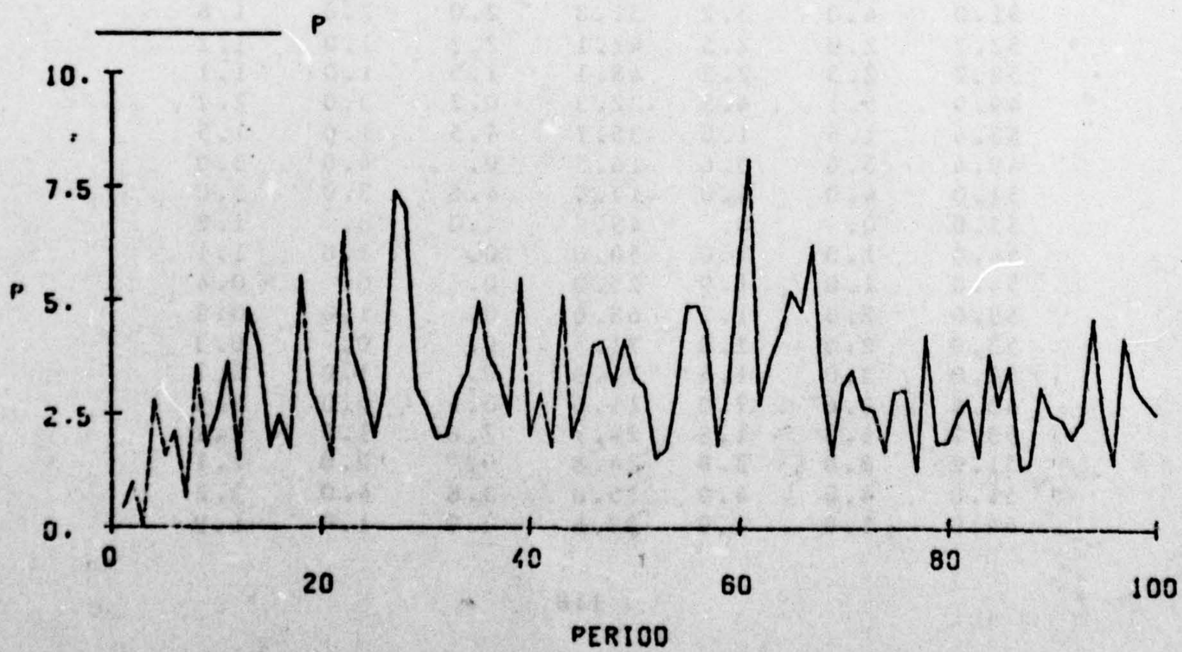
QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
5.7	26.3	10.7	1.0	9.7	6.0	5.8
0.3	31.7	21.5	0.0	6.7	12.0	10.8
14.8	17.2	8.2	2.8	18.5	4.0	5.4
13.0	19.0	14.4	1.6	7.2	9.0	8.3
18.4	13.6	13.6	2.1	14.4	9.0	8.9
9.0	23.0	23.0	0.7	5.6	15.0	13.8
24.0	8.0	8.0	3.6	20.0	5.0	6.8
18.0	14.0	14.0	1.8	5.0	11.0	10.2
23.0	9.0	9.0	2.5	14.0	9.0	9.2
24.0	8.0	8.0	3.6	7.0	6.0	6.6
15.0	17.0	17.0	1.5	2.0	11.0	10.1
25.0	7.0	6.3	4.8	14.0	4.0	5.2
23.3	8.7	7.8	4.0	4.3	6.0	5.8
19.1	12.9	12.9	1.8	7.8	12.0	10.8
23.0	9.0	9.0	2.5	12.9	9.0	9.4
20.0	12.0	12.0	1.7	9.0	12.0	11.5
26.0	6.0	5.1	5.5	9.0	3.0	4.7
20.1	11.9	9.7	3.1	1.1	7.0	6.5
16.8	15.2	11.0	2.4	3.7	7.0	6.9
15.8	16.2	16.2	1.6	10.0	11.0	10.2
29.0	3.0	3.0	6.5	16.2	3.0	4.4
25.0	7.0	7.0	3.9	3.0	7.0	6.5
24.0	8.0	8.0	3.1	7.0	8.0	7.7
19.0	13.0	13.0	2.0	5.0	10.0	9.5
22.0	10.0	10.0	2.9	10.0	7.0	7.5
29.0	3.0	3.0	7.4	10.0	3.0	3.9
28.0	4.0	4.0	7.0	3.0	4.0	4.0
22.0	10.0	10.0	3.1	2.0	8.0	7.2
23.0	9.0	9.0	2.7	10.0	9.0	8.6
21.0	11.0	11.0	2.0	9.0	11.0	10.5
19.0	13.0	13.0	2.0	7.0	9.0	9.3
24.0	8.0	8.0	2.9	13.0	8.0	8.3
25.0	7.0	7.0	3.4	8.0	7.0	7.3
27.0	5.0	5.0	5.0	7.0	5.0	5.5
22.0	10.0	8.1	3.7	1.0	6.0	5.9
20.1	11.9	8.6	3.4	4.1	6.0	6.0
18.7	13.3	12.1	2.5	6.6	8.0	7.6
25.8	6.2	5.1	5.5	11.1	4.0	4.7
17.9	14.1	14.1	2.0	2.1	10.0	8.9

QS	QR	X	P	Y	Z	CP
24.0	8.0	8.0	2.9	14.1	8.0	8.2
20.0	12.0	12.0	1.8	8.0	12.0	11.2
28.0	4.0	4.0	5.1	12.0	4.0	5.4
20.0	12.0	12.0	2.0	3.0	11.0	9.9
23.0	9.0	9.0	2.7	11.0	8.0	8.4
26.0	6.0	6.0	4.0	9.0	6.0	6.5
25.0	7.0	7.0	4.1	5.0	6.0	6.1
24.0	8.0	8.0	3.2	7.0	8.0	7.6
23.0	9.0	7.2	4.2	4.0	5.0	5.5
22.2	9.8	9.7	3.3	6.2	7.0	6.7
23.9	8.1	8.1	3.1	9.7	8.0	7.7
16.0	16.0	16.0	1.5	3.1	11.0	10.3
19.0	13.0	13.0	1.7	14.0	11.0	10.9
22.0	10.0	10.0	2.8	10.0	7.0	7.8
27.0	5.0	5.0	4.9	10.0	5.0	5.6
25.0	7.0	6.1	4.9	3.0	5.0	5.1
25.1	6.9	6.9	4.3	6.1	6.0	5.8
18.0	14.0	14.0	1.8	3.9	11.0	10.0
24.0	8.0	8.0	3.2	13.0	7.0	7.6
24.0	8.0	7.8	6.1	3.0	3.0	3.9
25.8	6.2	6.2	8.1	4.8	3.0	3.2
19.0	13.0	10.9	2.7	1.2	8.0	7.0
22.9	9.1	8.6	3.7	9.9	6.0	6.2
25.5	6.5	6.5	4.2	8.6	6.0	6.0
27.0	5.0	5.0	5.2	6.5	5.0	5.2
24.0	8.0	6.1	4.8	2.0	5.0	5.0
26.1	5.9	5.9	6.2	6.1	4.0	4.2
24.0	8.0	8.0	3.3	5.9	8.0	7.2
19.0	13.0	13.0	1.6	8.0	13.0	11.8
25.0	7.0	7.0	3.1	13.0	7.0	8.0
25.0	7.0	7.0	3.5	7.0	7.0	7.2
23.0	9.0	9.0	2.7	7.0	9.0	8.6
23.0	9.0	9.0	2.6	9.0	9.0	8.9
18.0	14.0	14.0	1.7	6.0	11.0	10.6
23.0	9.0	9.0	3.0	12.0	7.0	7.7
24.0	8.0	8.0	3.0	9.0	8.0	7.9
15.0	17.0	17.0	1.3	4.0	13.0	12.0
27.0	5.0	5.0	4.2	17.0	5.0	6.4
20.0	12.0	12.0	1.8	5.0	12.0	10.9
21.0	11.0	11.0	1.9	12.0	11.0	11.0
22.0	10.0	10.0	2.6	9.0	8.0	8.6
23.0	9.0	9.0	2.8	9.0	8.0	8.1
15.0	17.0	16.7	1.6	2.0	10.0	9.6
25.7	6.3	6.3	3.8	16.7	6.0	6.7
23.0	9.0	9.0	2.7	6.3	9.0	8.5
23.0	9.0	9.0	3.5	6.0	6.0	6.5
16.0	16.0	16.0	1.3	7.0	14.0	12.5
17.0	15.0	15.0	1.4	13.0	12.0	12.1

QS	QR	X	P	Y	Z	CP
25.0	7.0	7.0	3.1	15.0	7.0	8.0
18.0	14.0	11.4	2.5	0.	7.0	7.2
20.4	11.6	11.6	2.4	11.4	9.0	8.6
21.0	11.0	11.0	2.0	11.6	11.0	10.5
22.0	10.0	10.0	2.4	10.0	9.0	9.3
27.0	5.0	5.0	4.6	10.0	5.0	5.9
22.0	10.0	10.0	2.6	4.0	9.0	8.4
17.0	15.0	15.0	1.4	8.0	13.0	12.1
27.0	5.0	5.0	4.2	15.0	5.0	6.4
24.0	8.0	8.0	3.1	5.0	8.0	7.7
20.0	12.0	10.9	2.8	3.0	7.0	7.1
21.9	10.1	10.1	2.5	10.9	9.0	8.6



OS=2.
OR=30.
CP=5.
ALPHA=.8
OLAMDA=8.
OR
GS
30
20
10
0
OS
OR
0
20
40
60
80
100
PERIOD



P
10.
7.5
5.
2.5
0.
P
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

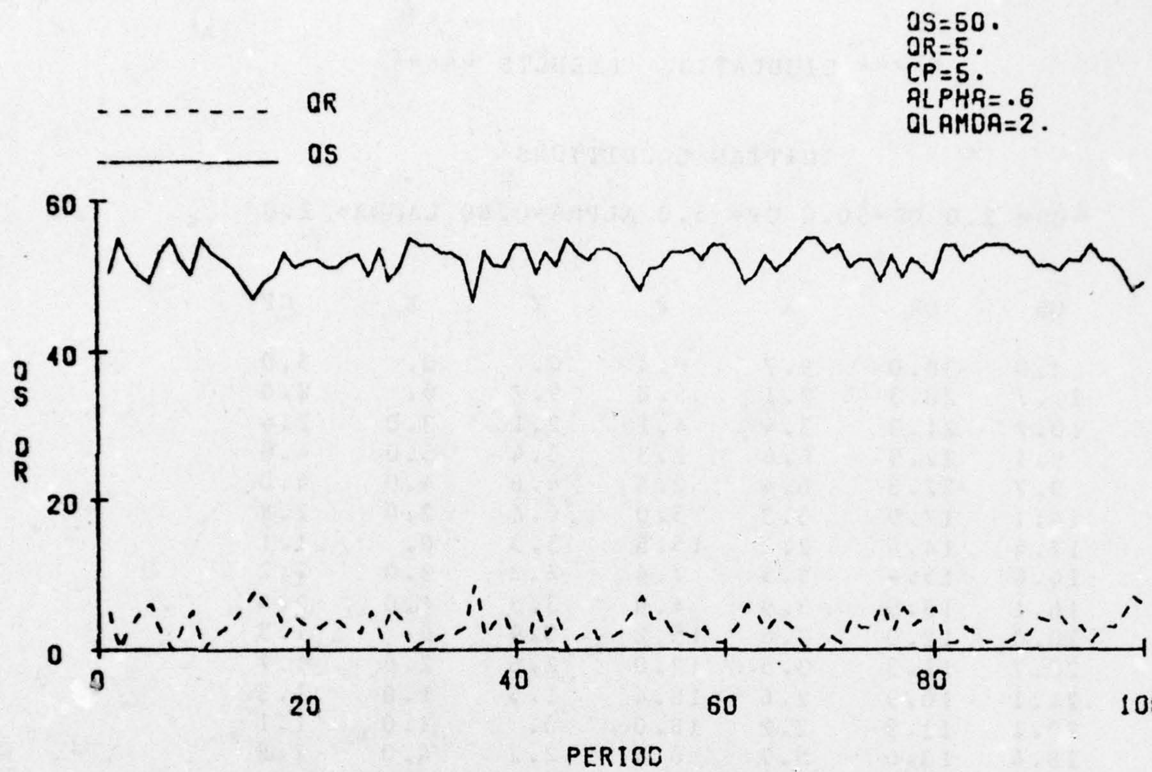
INITIAL CONDITIONS

QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.60 LAMDA= 2.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
55.0	0.	0.	27.5	5.0	0.	2.0
52.0	3.0	3.0	20.0	0.	3.0	2.6
50.0	5.0	5.0	12.4	3.0	5.0	4.0
49.0	6.0	6.0	12.2	3.0	4.0	4.0
53.0	2.0	2.0	18.9	6.0	2.0	2.8
55.0	0.	0.	49.0	2.0	0.	1.1
52.0	3.0	3.0	23.1	0.	3.0	2.2
50.0	5.0	5.0	15.2	2.0	4.0	3.3
55.0	0.	0.	41.7	5.0	0.	1.3
53.0	2.0	2.0	30.7	0.	2.0	1.7
52.0	3.0	2.6	40.3	0.	1.0	1.3
51.0	4.0	2.2	45.7	0.	1.0	1.1
49.2	5.8	5.7	17.3	2.2	4.0	2.8
46.9	8.1	7.1	13.3	1.7	4.0	3.5
49.0	6.0	6.0	12.8	6.1	4.0	3.8
50.0	5.0	5.0	18.3	3.0	2.0	2.7
53.0	2.0	2.0	31.4	4.0	1.0	1.7
51.0	4.0	3.8	27.2	0.	2.0	1.9
51.8	3.2	3.2	20.3	3.8	3.0	2.6
52.0	3.0	2.0	51.0	0.2	0.	1.0
51.0	4.0	2.0	50.6	0.	1.0	1.0
51.0	4.0	3.2	31.8	2.0	2.0	1.6
52.2	2.8	2.5	42.1	2.2	1.0	1.2
52.7	2.3	2.2	48.1	1.5	1.0	1.1
49.9	5.1	4.5	22.3	0.2	3.0	2.2
53.4	1.6	1.6	35.7	4.5	1.0	1.5
49.4	5.6	5.6	16.5	0.	4.0	3.0
51.0	4.0	4.0	17.0	4.6	3.0	3.0
55.0	0.	0.	45.8	4.0	0.	1.2
54.0	1.0	1.0	50.0	0.	1.0	1.1
54.0	1.0	1.0	25.0	0.	0.	0.4
53.0	2.0	1.5	68.6	0.	1.0	0.8
53.0	2.0	1.0	71.5	0.	0.	0.3
52.0	3.0	1.4	71.9	0.	1.0	0.7
46.4	8.6	7.8	11.9	0.4	6.0	3.9
53.2	1.8	1.8	24.7	7.8	1.0	2.2
51.2	3.8	3.8	24.8	0.	2.0	2.1
51.0	4.0	4.0	15.8	3.8	4.0	3.2
54.0	1.0	1.0	28.6	4.0	1.0	1.9

QS	QR	X	P	Y	Z	CP
54.0	1.0	1.0	39.8	1.0	1.0	1.4
50.0	5.0	5.0	17.0	0.	4.0	2.9
53.0	2.0	2.0	29.8	4.0	1.0	1.8
51.0	4.0	4.0	16.4	2.0	4.0	3.1
55.0	0.	0.	44.2	4.0	0.	1.2
53.0	2.0	2.0	31.2	0.	2.0	1.7
52.0	3.0	2.6	40.7	0.	1.0	1.3
53.6	1.4	1.4	48.2	2.6	1.0	1.1
53.6	1.4	1.0	20.4	0.	0.	0.4
52.6	2.4	1.6	67.6	0.	1.0	0.8
50.1	4.9	4.9	18.5	1.6	4.0	2.7
48.0	7.0	5.8	16.6	0.9	3.0	2.9
50.8	4.2	4.2	21.6	4.8	2.0	2.4
51.0	4.0	1.9	54.2	0.2	0.	0.9
52.9	2.1	1.0	40.4	1.9	0.	0.4
52.9	2.1	1.5	70.5	1.0	1.0	0.8
53.4	1.6	1.6	59.3	1.5	1.0	0.9
52.0	3.0	3.0	24.1	1.6	3.0	2.2
54.0	1.0	1.0	36.9	3.0	1.0	1.5
54.0	1.0	1.0	92.2	0.	0.	0.6
52.0	3.0	2.9	36.3	0.	2.0	1.4
48.9	6.1	5.9	16.4	0.9	4.0	3.0
49.8	5.2	4.8	20.8	2.9	2.0	2.4
52.6	2.4	2.4	24.4	4.8	2.0	2.2
50.6	4.4	4.1	24.5	0.	2.0	2.1
51.7	3.3	2.8	36.3	2.1	1.0	1.4
53.6	1.4	1.4	45.8	2.8	1.0	1.2
55.0	0.	1.0	17.5	1.4	0.	0.5
55.0	0.	0.	69.9	1.0	1.0	0.8
53.0	2.0	2.0	35.0	0.	2.0	1.5
54.0	1.0	1.0	44.8	2.0	1.0	1.2
51.0	4.0	4.0	22.3	0.	3.0	2.3
52.0	3.0	3.0	34.4	2.0	1.0	1.5
52.0	3.0	3.0	21.6	3.0	3.0	2.4
49.0	6.0	5.5	17.7	0.	3.0	2.8
52.5	2.5	2.5	22.8	5.5	2.0	2.3
49.5	5.5	5.4	18.2	0.	3.0	2.7
52.0	3.0	3.0	18.0	5.4	3.0	2.9
51.0	4.0	3.5	29.0	0.	1.0	1.8
49.5	5.5	5.5	13.4	3.5	5.0	3.7
54.0	1.0	1.0	26.0	5.5	1.0	2.1
54.0	1.0	1.0	64.9	0.	0.	0.8
52.0	3.0	3.0	33.9	0.	2.0	1.5
53.0	2.0	2.0	43.7	2.0	1.0	1.2
54.0	1.0	1.0	49.8	2.0	1.0	1.1
54.0	1.0	1.0	52.2	1.0	1.0	1.0
54.0	1.0	1.0	53.3	1.0	1.0	1.0
53.0	2.0	2.0	52.7	0.	1.0	1.0

QS	QR	X	P	Y	Z	CP
53.0	2.0	2.0	52.9	1.0	1.0	1.0
51.0	4.0	3.2	31.9	0.	2.0	1.6
51.2	3.8	2.5	41.3	1.2	1.0	1.2
50.7	4.3	4.3	22.1	2.5	3.0	2.3
52.0	3.0	1.8	56.6	1.3	0.	0.9
51.8	3.2	3.1	33.1	1.8	2.0	1.6
54.0	1.0	1.0	44.0	3.1	1.0	1.2
52.0	3.0	3.0	30.7	0.	2.0	1.7
52.0	3.0	2.6	40.7	1.0	1.0	1.3
50.6	4.4	3.4	29.6	0.6	2.0	1.7
48.0	7.0	5.0	19.3	0.4	3.0	2.5
48.9	6.1	4.4	22.3	3.0	2.0	2.2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QR=5.
CP=5.
ALPHA=.6
QLAMDA=2.
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QS
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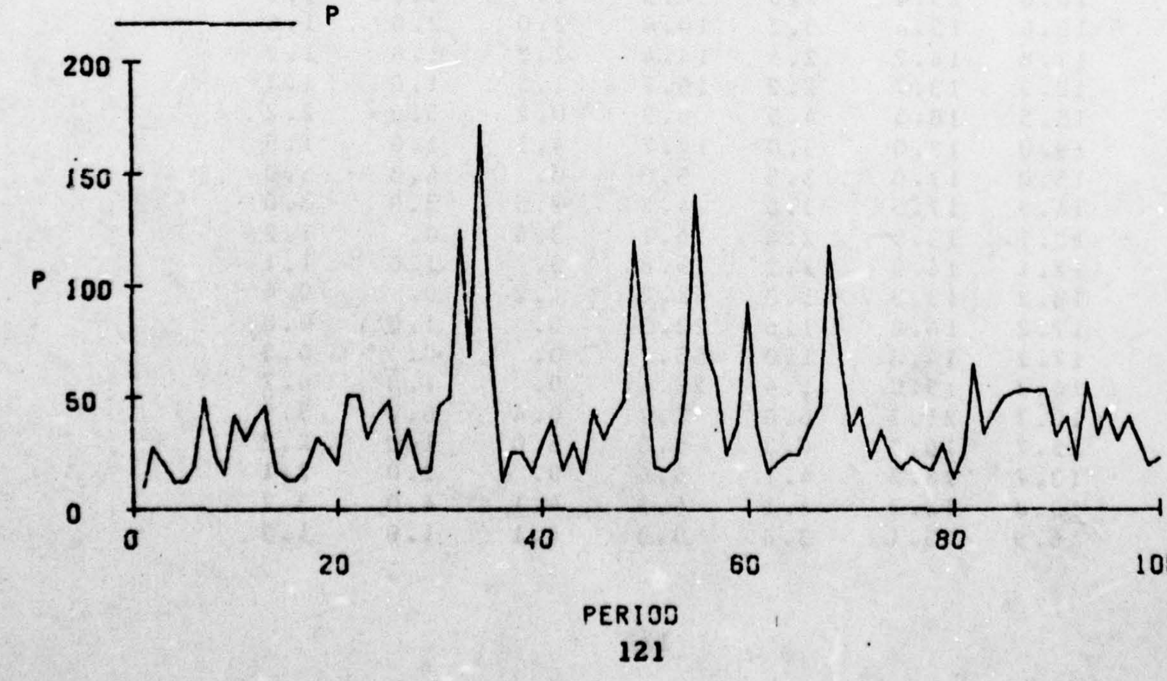
40
20
0
QS
QR
0
20
40
60
80
100
PERIOD


P
200
150
100
50
0
P
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

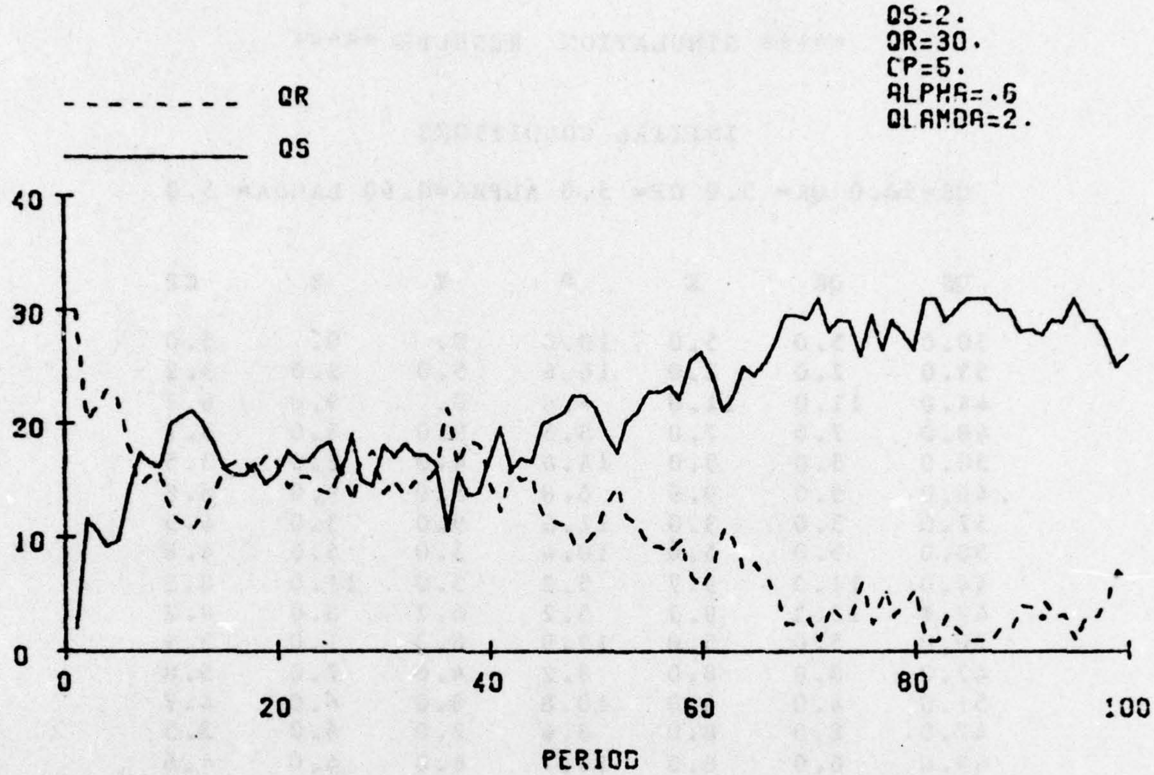
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.60 LAMDA= 2.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
11.7	20.3	2.1	5.8	9.7	0.	2.0
10.7	21.3	3.4	4.1	2.1	3.0	2.6
9.1	22.9	6.6	2.3	3.4	5.0	4.0
9.7	22.3	6.4	2.4	4.6	4.0	4.0
14.1	17.9	3.3	5.0	6.4	2.0	2.8
17.4	14.6	2.2	15.5	3.3	0.	1.1
16.6	15.4	4.5	7.4	2.2	3.0	2.2
16.1	15.9	3.9	4.9	3.5	4.0	3.3
20.0	12.0	2.6	15.2	3.9	0.	1.3
20.7	11.3	3.5	12.0	2.6	2.0	1.7
21.1	10.9	2.6	16.4	1.5	1.0	1.3
20.1	11.9	2.2	18.0	0.	1.0	1.1
18.4	13.6	5.7	6.4	2.2	4.0	2.8
16.0	16.0	4.4	4.5	1.7	4.0	3.5
15.5	16.5	5.1	4.0	3.4	4.0	3.8
15.5	16.5	2.9	5.7	2.1	2.0	2.7
16.4	15.6	3.4	9.7	1.9	1.0	1.7
14.8	17.2	3.8	7.9	0.4	2.0	1.9
15.5	16.5	5.1	6.1	3.8	3.0	2.6
17.6	14.4	2.0	17.3	2.1	0.	1.0
16.6	15.4	2.0	16.5	0.	1.0	1.0
16.6	15.4	3.2	10.4	2.0	2.0	1.6
17.8	14.2	2.5	14.4	2.2	1.0	1.2
18.3	13.7	2.2	16.7	1.5	1.0	1.1
15.5	16.5	4.5	6.9	0.2	3.0	2.2
19.0	13.0	3.0	12.7	4.5	1.0	1.5
15.0	17.0	3.5	5.0	0.	4.0	3.0
14.5	17.5	3.6	4.8	2.5	3.0	3.0
18.1	13.9	2.4	15.1	3.6	0.	1.2
17.1	14.9	2.2	15.8	0.	1.0	1.1
18.2	13.8	1.0	42.2	1.2	0.	0.4
17.2	14.8	1.5	22.3	0.	1.0	0.8
17.2	14.8	1.0	55.7	0.	0.	0.3
16.2	15.8	1.4	22.4	0.	1.0	0.7
10.7	21.3	6.0	2.7	0.4	6.0	3.9
15.7	16.3	4.3	7.3	6.0	1.0	2.2
13.7	18.3	4.1	6.6	0.	2.0	2.1
13.8	18.2	4.1	4.3	4.1	4.0	3.2
16.9	15.1	3.8	9.0	4.1	1.0	1.9

QS	QR	X	P	Y	Z	CP
19.7	12.3	2.7	14.5	3.8	1.0	1.4
15.7	16.3	3.3	5.3	0.	4.0	2.9
17.0	15.0	3.6	9.6	2.3	1.0	1.8
16.5	15.5	3.5	5.3	3.6	4.0	3.1
20.0	12.0	2.5	16.1	3.5	0.	1.2
20.5	11.5	3.4	12.1	2.5	2.0	1.7
20.9	11.1	2.6	16.3	1.4	1.0	1.3
22.5	9.5	2.2	20.2	2.6	1.0	1.1
22.5	9.5	1.0	50.5	0.	0.	0.4
21.5	10.5	1.6	27.6	0.	1.0	0.8
19.0	13.0	5.4	7.0	1.6	4.0	2.7
17.4	14.6	5.8	6.0	1.4	3.0	2.9
20.2	11.8	4.7	8.6	4.8	2.0	2.4
20.9	11.1	1.9	22.2	0.7	0.	0.9
22.8	9.2	1.0	60.5	1.9	0.	0.4
22.8	9.2	1.5	30.4	1.0	1.0	0.8
23.3	8.7	1.8	25.9	1.5	1.0	0.9
22.1	9.9	4.3	10.2	1.8	3.0	2.2
25.4	6.6	2.9	17.4	4.3	1.0	1.5
26.3	5.7	1.2	45.0	0.9	0.	0.6
24.3	7.7	2.9	17.0	0.	2.0	1.4
21.2	10.8	5.9	7.1	0.9	4.0	3.0
22.2	9.8	4.8	9.3	2.9	2.0	2.4
24.9	7.1	4.3	11.6	4.8	2.0	2.2
24.2	7.8	4.1	11.8	1.3	2.0	2.1
25.4	6.6	2.8	17.8	2.1	1.0	1.4
27.2	4.8	2.3	23.3	2.8	1.0	1.2
29.6	2.4	1.0	63.2	2.3	0.	0.5
29.6	2.4	1.6	37.6	1.0	1.0	0.8
29.1	2.9	2.9	19.2	1.6	2.0	1.5
31.0	1.0	1.0	25.7	2.9	1.0	1.2
28.0	4.0	4.0	12.3	0.	3.0	2.3
29.0	3.0	3.0	19.2	2.0	1.0	1.5
29.0	3.0	3.0	12.1	3.0	3.0	2.4
26.0	6.0	5.5	9.4	0.	3.0	2.8
29.5	2.5	2.5	12.8	5.5	2.0	2.3
26.5	5.5	5.4	9.7	0.	3.0	2.7
29.0	3.0	3.0	10.0	5.4	3.0	2.9
28.0	4.0	3.5	15.9	0.	1.0	1.8
26.5	5.5	5.5	7.2	3.5	5.0	3.7
31.0	1.0	1.0	14.9	5.5	1.0	2.1
31.0	1.0	1.0	37.2	0.	0.	0.8
29.0	3.0	3.0	18.9	0.	2.0	1.5
30.0	2.0	2.0	24.7	2.0	1.0	1.2
31.0	1.0	1.0	28.6	2.0	1.0	1.1
31.0	1.0	1.0	30.0	1.0	1.0	1.0
31.0	1.0	1.0	30.6	1.0	1.0	1.0
30.0	2.0	2.0	29.8	0.	1.0	1.0

QS	QR	X	P	Y	Z	CP
30.0	2.0	2.0	29.9	1.0	1.0	1.0
28.0	4.0	3.2	17.5	0.	2.0	1.6
28.2	3.8	2.5	22.7	1.2	1.0	1.2
27.7	4.3	4.3	12.1	2.5	3.0	2.3
29.0	3.0	1.8	31.6	1.3	0.	0.9
28.8	3.2	3.1	18.4	1.8	2.0	1.6
31.0	1.0	1.0	25.2	3.1	1.0	1.2
29.0	3.0	3.0	17.1	0.	2.0	1.7
29.0	3.0	2.6	22.7	1.0	1.0	1.3
27.6	4.4	3.4	16.1	0.6	2.0	1.7
25.0	7.0	5.0	10.1	0.4	3.0	2.5
25.9	6.1	4.4	11.8	3.0	2.0	2.2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CP=5.
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80
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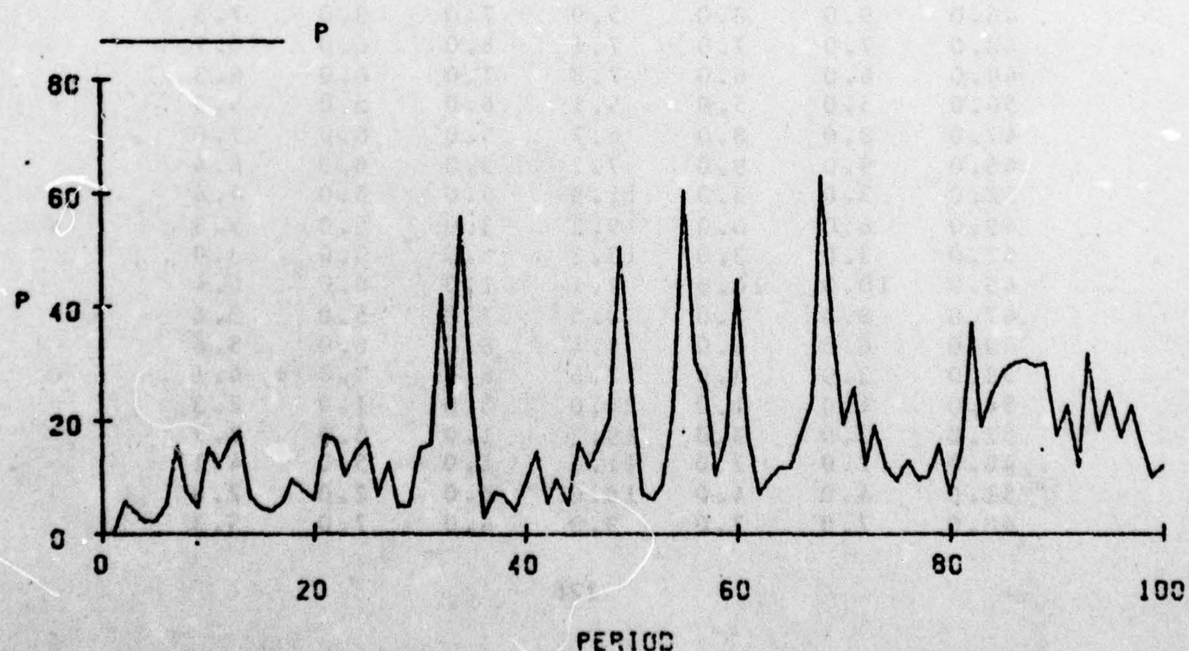
PERIOD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P
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20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

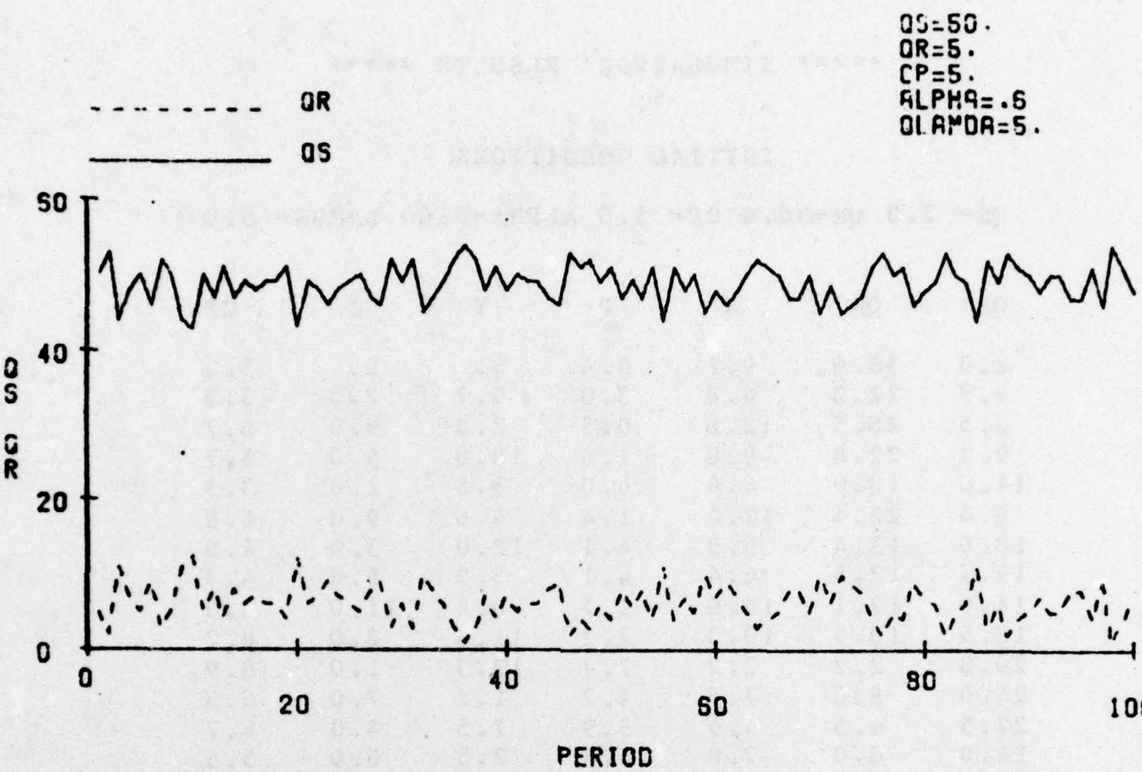
INITIAL CONDITIONS

QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.60 LAMDA= 5.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
53.0	2.0	2.0	16.6	5.0	2.0	3.2
44.0	11.0	11.0	6.6	0.	9.0	6.7
48.0	7.0	7.0	8.5	9.0	5.0	5.7
50.0	5.0	5.0	14.4	4.0	2.0	3.5
46.0	9.0	9.0	6.8	5.0	9.0	6.8
52.0	3.0	3.0	11.5	9.0	3.0	4.5
50.0	5.0	5.0	10.4	3.0	5.0	4.8
44.0	11.0	9.7	5.2	5.0	11.0	8.5
42.7	12.3	9.3	5.2	6.7	8.0	8.2
50.0	5.0	5.0	12.9	8.3	1.0	3.9
47.0	8.0	8.0	8.2	4.0	7.0	5.8
51.0	4.0	4.0	10.8	8.0	4.0	4.7
47.0	8.0	8.0	8.6	2.0	6.0	5.5
49.0	6.0	6.0	10.7	6.0	4.0	4.6
48.0	7.0	7.0	8.8	5.0	6.0	5.4
49.0	6.0	6.0	9.5	6.0	5.0	5.2
49.0	6.0	6.0	12.7	3.0	3.0	3.9
51.0	4.0	4.0	15.2	5.0	3.0	3.3
43.0	12.0	12.0	6.4	1.0	9.0	6.7
49.0	6.0	6.0	7.8	12.0	6.0	6.3
48.0	7.0	7.0	7.8	5.0	6.0	6.1
46.0	9.0	8.0	5.9	7.0	9.0	7.8
48.0	7.0	7.0	7.1	8.0	6.0	6.7
49.0	6.0	6.0	7.8	7.0	6.0	6.3
50.0	5.0	5.0	9.1	6.0	5.0	5.5
47.0	8.0	8.0	6.7	5.0	8.0	7.0
46.0	9.0	9.0	7.2	5.0	6.0	6.4
52.0	3.0	3.0	11.9	9.0	3.0	4.4
49.0	6.0	6.0	9.2	3.0	6.0	5.3
52.0	3.0	3.0	13.2	6.0	3.0	3.9
45.0	10.0	10.0	7.1	1.0	8.0	6.4
47.0	8.0	8.0	8.5	7.0	5.0	5.6
49.0	6.0	6.0	8.4	8.0	6.0	5.8
52.0	3.0	3.0	12.6	6.0	3.0	4.1
54.0	1.0	1.0	24.0	3.0	1.0	2.3
52.0	3.0	3.0	19.3	1.0	3.0	2.7
48.0	7.0	7.0	11.8	1.0	5.0	4.1
51.0	4.0	4.0	18.0	5.0	2.0	2.8
48.0	7.0	7.0	9.0	4.0	7.0	5.3

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	9.7	7.0	5.0	5.1
49.0	6.0	6.0	9.7	4.0	5.0	5.1
49.0	6.0	6.0	15.2	2.0	2.0	3.2
47.0	8.0	8.0	8.6	5.0	7.0	5.5
46.0	9.0	9.0	10.0	3.0	4.0	4.6
53.0	2.0	2.0	21.7	8.0	1.0	2.4
51.0	4.0	4.0	15.1	2.0	4.0	3.4
52.0	3.0	3.0	16.5	4.0	3.0	3.2
49.0	6.0	6.0	10.1	3.0	6.0	4.9
51.0	4.0	4.0	16.2	4.0	2.0	3.1
47.0	8.0	7.3	12.8	0.	4.0	3.7
49.3	5.7	5.7	11.0	7.3	5.0	4.5
47.0	8.0	8.0	9.8	2.7	5.0	4.8
51.0	4.0	4.0	16.4	6.0	2.0	3.1
44.0	11.0	11.0	7.3	1.0	8.0	6.0
51.0	4.0	4.0	16.9	8.0	1.0	3.0
48.0	7.0	7.0	8.9	4.0	7.0	5.4
50.0	5.0	5.0	9.7	7.0	5.0	5.2
45.0	10.0	10.0	6.0	4.0	9.0	7.5
48.0	7.0	7.0	6.7	10.0	7.0	7.2
46.0	9.0	9.0	6.5	5.0	7.0	7.1
48.0	7.0	7.0	8.2	7.0	5.0	5.8
50.0	5.0	5.0	9.4	7.0	5.0	5.3
52.0	3.0	3.0	13.2	5.0	3.0	3.9
51.0	4.0	4.0	12.8	3.0	4.0	4.0
50.0	5.0	5.0	12.5	3.0	4.0	4.0
47.0	8.0	8.0	11.8	1.0	4.0	4.0
47.0	8.0	8.0	11.8	4.0	4.0	4.0
50.0	5.0	5.0	10.9	8.0	5.0	4.6
45.0	10.0	9.7	9.3	0.	5.0	4.8
48.7	6.3	6.3	8.8	9.7	6.0	5.5
45.0	10.0	10.0	7.0	3.3	7.0	6.4
46.0	9.0	8.3	5.8	10.0	9.0	8.0
47.3	7.7	7.7	8.5	5.3	4.0	5.6
51.0	4.0	4.0	12.6	6.7	3.0	4.0
53.0	2.0	2.0	18.8	4.0	2.0	2.8
50.0	5.0	5.0	12.1	2.0	5.0	4.1
51.0	4.0	4.0	14.8	4.0	3.0	3.5
46.0	9.0	9.0	9.2	1.0	6.0	5.0
48.0	7.0	7.0	7.8	9.0	7.0	6.2
49.0	6.0	6.0	8.9	6.0	5.0	5.5
53.0	2.0	2.0	15.6	6.0	2.0	3.4
50.0	5.0	5.0	13.3	1.0	4.0	3.8
49.0	6.0	6.0	9.6	5.0	6.0	5.1
44.0	11.0	11.0	7.8	1.0	6.0	5.6
52.0	3.0	3.0	12.8	11.0	3.0	4.1
49.0	6.0	6.0	14.3	0.	3.0	3.4
53.0	2.0	2.0	26.9	5.0	1.0	2.0

QS	QR	X	P	Y	Z	CP
51.0	4.0	4.0	16.0	2.0	4.0	3.2
50.0	5.0	5.0	20.2	1.0	2.0	2.5
43.0	7.0	7.0	12.0	3.0	5.0	4.0
50.0	5.0	5.0	14.7	5.0	3.0	3.4
50.0	5.0	5.0	13.3	4.0	4.0	3.8
47.0	8.0	8.0	8.2	4.0	7.0	5.7
47.0	8.0	8.0	8.0	6.0	6.0	5.9
51.0	4.0	4.0	10.7	8.0	4.0	4.8
46.0	9.0	9.0	8.4	1.0	6.0	5.5
54.0	1.0	1.0	19.3	9.0	1.0	2.8
51.0	4.0	4.0	14.5	1.0	4.0	3.5
48.0	7.0	7.0	9.6	3.0	6.0	5.0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ALPHA=.6
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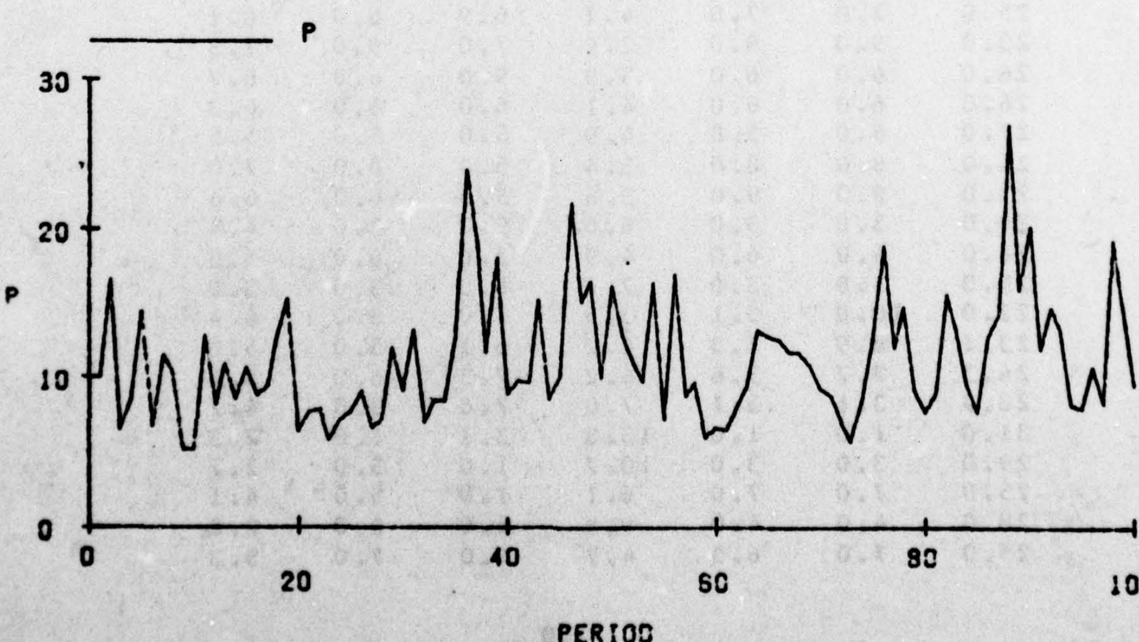
Q S
Q R
PERIOD


P
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10
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30
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

INITIAL CONDITIONS

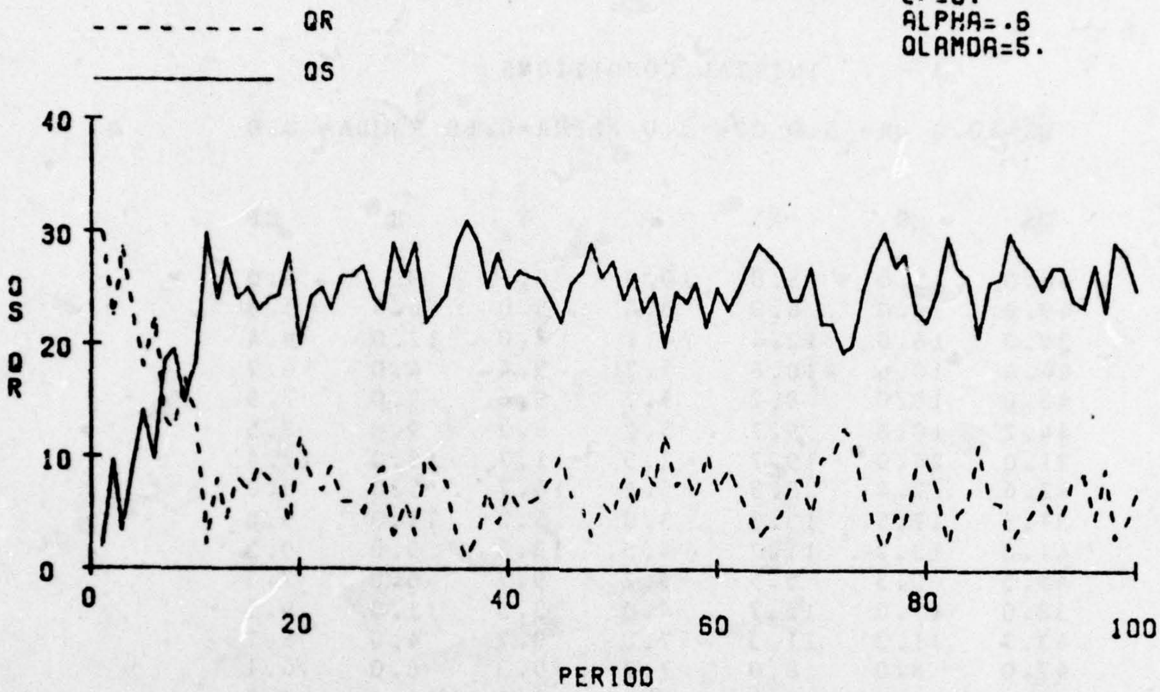
QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.60 LAMDA= 5.0

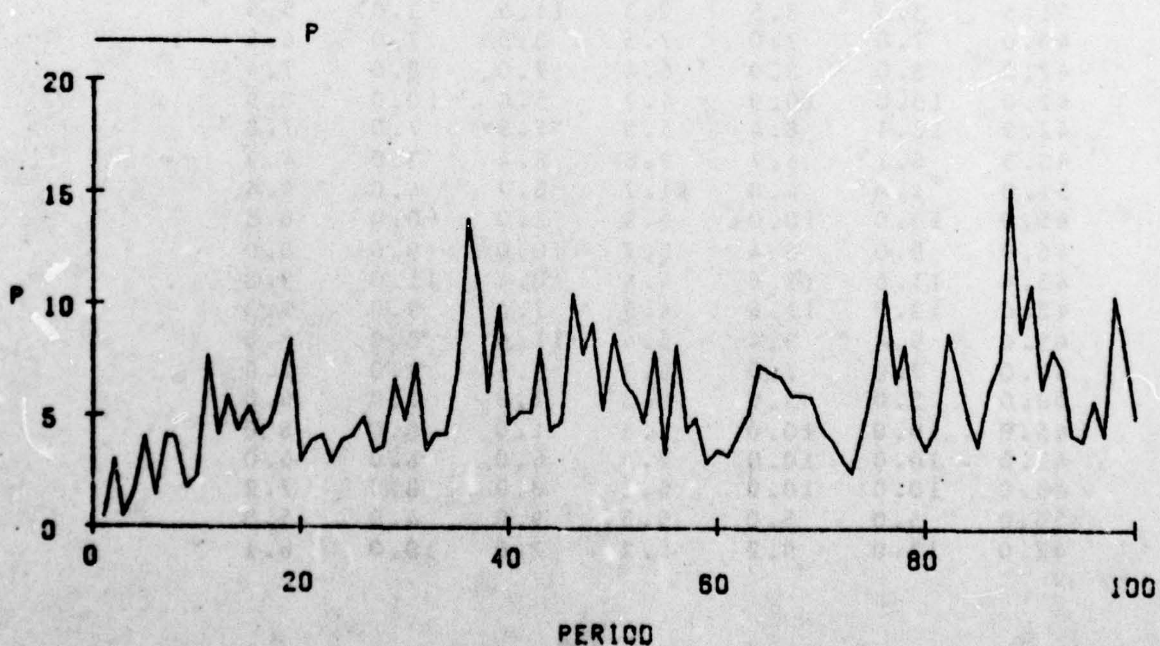
QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
9.7	22.3	4.8	3.0	9.7	2.0	3.2
3.5	28.5	12.8	0.5	2.8	9.0	6.7
9.2	22.8	9.8	1.6	10.8	5.0	5.7
14.0	18.0	4.6	4.0	6.8	2.0	3.5
9.6	22.4	12.0	1.4	4.6	9.0	6.8
18.6	13.4	5.9	4.1	12.0	3.0	4.5
19.5	12.5	6.4	4.1	5.9	5.0	4.8
14.9	17.1	14.6	1.7	6.4	11.0	8.5
18.5	13.5	13.3	2.2	11.6	8.0	8.2
29.8	2.2	2.2	7.7	12.3	1.0	3.9
24.0	8.0	7.5	4.2	1.2	7.0	5.8
27.5	4.5	4.5	5.9	7.5	4.0	4.7
24.0	8.0	7.0	4.4	2.5	6.0	5.5
25.0	7.0	5.0	5.4	5.0	4.0	4.6
23.0	9.0	7.0	4.2	4.0	6.0	5.4
24.0	8.0	6.3	4.6	6.0	5.0	5.2
24.4	7.6	7.6	6.3	3.3	3.0	3.9
28.0	4.0	4.0	8.4	6.6	3.0	3.3
20.0	12.0	10.1	3.0	1.0	9.0	6.7
24.1	7.9	7.9	3.8	10.1	6.0	6.3
25.0	7.0	7.0	4.1	6.9	6.0	6.1
23.0	9.0	9.0	2.9	7.0	9.0	7.8
26.0	6.0	6.0	3.9	9.0	6.0	6.7
26.0	6.0	6.0	4.1	6.0	6.0	6.3
27.0	5.0	5.0	4.9	6.0	5.0	5.5
24.0	8.0	8.0	3.4	5.0	8.0	7.0
23.0	9.0	9.0	3.6	5.0	6.0	6.4
29.0	3.0	3.0	6.6	9.0	3.0	4.4
26.0	6.0	6.0	4.9	3.0	6.0	5.3
29.0	3.0	3.0	7.4	6.0	3.0	3.9
22.0	10.0	9.1	3.5	1.0	8.0	6.4
23.1	8.9	7.3	4.2	6.1	5.0	5.6
24.3	7.7	7.6	4.2	7.3	6.0	5.8
28.9	3.1	3.1	7.0	7.6	3.0	4.1
31.0	1.0	1.0	13.8	3.1	1.0	2.3
29.0	3.0	3.0	10.7	1.0	3.0	2.7
25.0	7.0	7.0	6.1	1.0	5.0	4.1
28.0	4.0	4.0	9.9	5.0	2.0	2.8
25.0	7.0	6.5	4.7	4.0	7.0	5.3

QS	QR	X	P	Y	Z	CP
26.5	5.5	5.5	5.2	6.5	5.0	5.1
26.0	6.0	5.8	5.1	4.5	5.0	5.1
25.8	6.2	6.2	8.0	1.8	2.0	3.2
24.0	8.0	7.0	4.4	5.2	7.0	5.5
22.0	10.0	5.5	4.8	2.0	4.0	4.6
25.5	6.5	4.9	10.5	4.5	1.0	2.4
26.4	5.6	5.6	7.8	4.9	4.0	3.4
29.0	3.0	3.0	9.2	5.6	3.0	3.2
26.0	6.0	5.4	5.3	3.0	6.0	4.9
27.4	4.6	4.6	8.7	3.4	2.0	3.1
24.0	8.0	7.3	6.6	0.6	4.0	3.7
26.3	5.7	4.5	5.9	7.3	5.0	4.5
22.9	9.1	5.8	4.8	1.5	5.0	4.8
24.6	7.4	6.2	7.9	3.8	2.0	3.1
19.8	12.2	8.8	3.3	3.2	8.0	6.0
24.6	7.4	6.0	8.2	5.8	1.0	3.0
23.7	8.3	6.9	4.4	6.0	7.0	5.4
25.5	6.5	6.1	4.9	6.9	5.0	5.2
21.6	10.4	10.4	2.9	5.1	9.0	7.5
25.0	7.0	7.0	3.5	10.4	7.0	7.2
23.0	9.0	9.0	3.3	5.0	7.0	7.1
25.0	7.0	7.0	4.3	7.0	5.0	5.8
27.0	5.0	5.0	5.1	7.0	5.0	5.3
29.0	3.0	3.0	7.4	5.0	3.0	3.9
28.0	4.0	4.0	7.0	3.0	4.0	4.0
27.0	5.0	5.0	6.8	3.0	4.0	4.0
24.0	8.0	8.0	6.0	1.0	4.0	4.0
24.0	8.0	8.0	6.0	4.0	4.0	4.0
27.0	5.0	4.7	5.9	8.0	5.0	4.6
22.0	10.0	6.0	4.5	0.	5.0	4.8
22.0	10.0	7.4	4.0	6.0	6.0	5.5
19.4	12.6	9.6	3.0	4.4	7.0	6.4
20.0	12.0	12.0	2.5	9.6	9.0	8.0
25.0	7.0	7.0	4.5	9.0	4.0	5.6
28.0	4.0	4.0	6.9	6.0	3.0	4.0
30.0	2.0	2.0	10.7	4.0	2.0	2.8
27.0	5.0	5.0	6.5	2.0	5.0	4.1
28.0	4.0	4.0	8.1	4.0	3.0	3.5
23.0	9.0	6.1	4.6	1.0	6.0	5.0
22.1	9.9	8.7	3.6	6.1	7.0	6.2
24.8	7.2	6.8	4.5	7.7	5.0	5.5
29.6	2.4	2.4	8.7	6.8	2.0	3.4
27.0	5.0	5.0	7.2	1.4	4.0	3.8
26.0	6.0	5.9	5.1	5.0	6.0	5.1
20.9	11.1	7.8	3.7	0.9	6.0	5.6
25.7	6.3	6.3	6.3	7.8	3.0	4.1
26.0	6.0	6.0	7.6	3.3	3.0	3.4
30.0	2.0	2.0	15.2	5.0	1.0	2.0

QS	QR	X	P	Y	Z	CP
28.0	4.0	4.0	8.8	2.0	4.0	3.2
27.0	5.0	5.0	10.9	1.0	2.0	2.5
25.0	7.0	7.0	6.3	3.0	5.0	4.0
27.0	5.0	5.0	8.0	5.0	3.0	3.4
27.0	5.0	5.0	7.2	4.0	4.0	3.8
24.0	8.0	7.4	4.2	4.0	7.0	5.7
23.4	8.6	7.9	4.0	5.4	6.0	5.9
27.3	4.7	4.7	5.7	7.9	4.0	4.8
23.0	9.0	7.2	4.2	1.7	6.0	5.5
29.2	2.8	2.8	10.4	7.2	1.0	2.8
28.0	4.0	4.0	8.0	2.8	4.0	3.5
25.0	7.0	5.8	5.0	3.0	6.0	5.0

QS=2.
QR=30.
CP=5.
ALPHA=.6
QLAMDA=5.





***** SIMULATION RESULTS *****

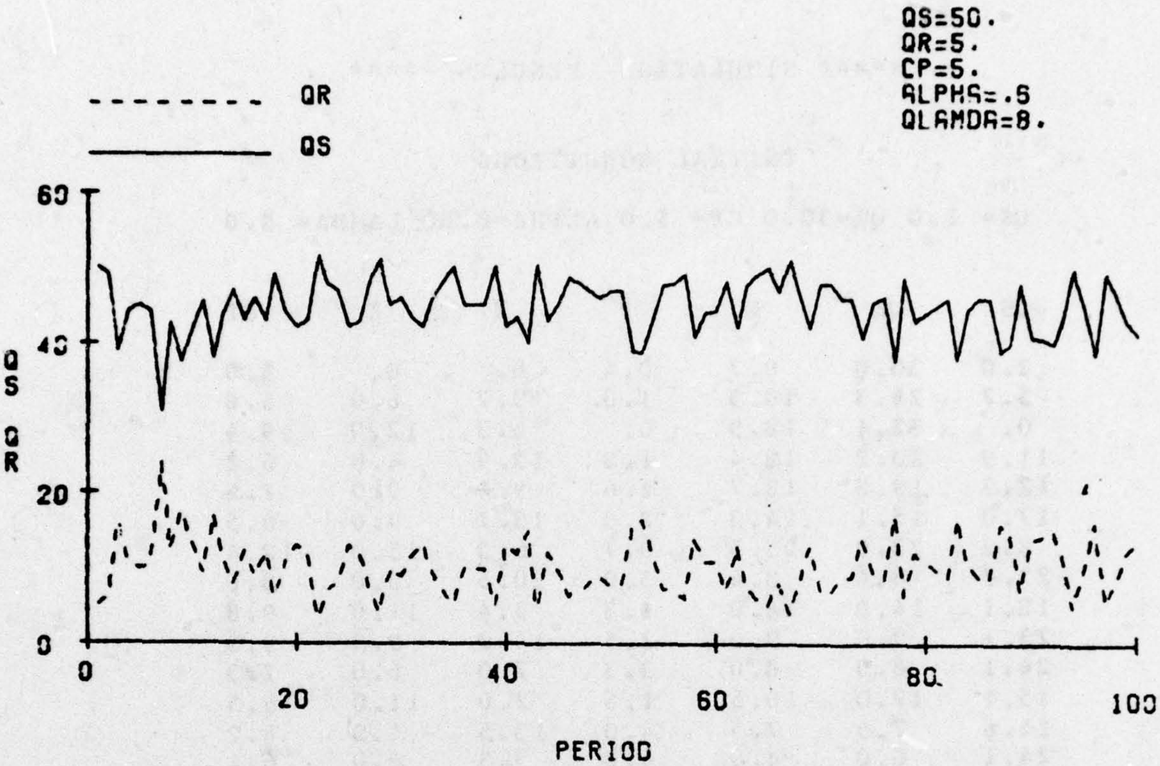
INITIAL CONDITIONS

QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.60 LAMDA= 8.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
49.0	6.0	6.0	8.8	5.0	6.0	5.6
39.0	16.0	12.4	4.1	2.0	12.0	9.4
44.4	10.6	10.6	7.2	9.4	4.0	6.2
45.0	10.0	8.2	5.7	9.6	9.0	7.9
44.2	10.8	9.7	5.2	8.2	9.0	8.5
31.0	24.0	19.7	2.5	1.7	15.0	12.4
42.6	12.4	8.8	5.4	16.7	5.0	8.0
37.5	17.5	13.3	3.8	5.8	11.0	9.8
41.8	13.2	11.7	4.5	13.3	9.0	9.3
45.5	9.5	9.5	6.2	9.7	6.0	7.3
38.0	17.0	12.7	4.0	3.5	11.0	9.5
43.7	11.3	11.3	7.0	9.7	4.0	6.2
47.0	8.0	8.0	7.7	9.3	6.0	6.1
43.0	12.0	12.0	4.5	8.0	12.0	9.6
46.0	9.0	9.0	5.0	12.0	9.0	9.3
43.0	12.0	12.0	3.9	9.0	12.0	10.9
49.0	6.0	6.0	8.0	9.0	3.0	6.2
44.0	11.0	11.0	6.6	2.0	7.0	6.7
42.0	13.0	13.0	6.1	5.0	7.0	6.9
43.0	12.0	11.5	4.6	12.0	11.0	9.3
51.5	3.5	3.5	9.3	11.5	3.0	5.5
48.0	7.0	7.0	7.5	3.5	7.0	6.4
47.0	8.0	8.0	6.4	7.0	8.0	7.4
42.0	13.0	10.9	4.7	5.0	10.0	8.9
42.9	12.1	8.4	5.5	7.9	7.0	7.8
48.3	6.7	6.7	9.8	8.4	3.0	4.9
51.0	4.0	4.0	11.7	6.7	4.0	4.4
45.0	10.0	10.0	6.9	2.0	8.0	6.5
46.0	9.0	8.4	5.7	10.0	9.0	8.0
43.4	11.6	11.6	4.4	8.4	11.0	9.8
42.0	13.0	11.6	4.5	7.6	9.0	9.3
45.6	9.4	9.4	5.4	11.6	8.0	8.5
48.0	7.0	7.0	6.3	9.4	7.0	7.6
50.0	5.0	5.0	8.3	7.0	5.0	6.0
45.0	10.0	10.0	7.5	1.0	6.0	6.0
45.0	10.0	10.0	7.5	6.0	6.0	6.0
45.0	10.0	10.0	6.2	8.0	8.0	7.2
50.0	5.0	5.0	9.5	9.0	4.0	5.3
42.0	13.0	9.2	5.2	2.0	10.0	8.1

QS	QR	X	P	Y	Z	CP
43.2	11.8	8.9	5.4	9.2	8.0	8.0
40.1	14.9	14.2	3.9	8.9	12.0	10.4
50.3	4.7	4.7	7.7	14.2	4.0	6.6
43.0	12.0	11.3	4.7	3.7	11.0	9.2
45.3	9.7	9.4	5.3	10.3	8.0	8.5
48.7	6.3	6.3	7.0	9.4	6.0	7.0
48.0	7.0	7.0	7.5	5.3	6.0	6.4
47.0	8.0	8.0	6.4	7.0	8.0	7.4
46.0	9.0	9.0	7.7	4.0	5.0	5.9
47.0	8.0	8.0	7.1	8.0	7.0	6.6
47.0	8.0	8.0	6.3	8.0	8.0	7.4
39.0	16.0	12.6	4.1	3.0	11.0	9.6
38.6	16.4	14.4	3.7	10.6	11.0	10.4
43.1	11.9	9.6	5.1	11.4	7.0	8.4
47.6	7.4	7.4	7.5	9.6	5.0	6.3
48.0	7.0	7.0	8.7	5.4	5.0	5.5
49.0	6.0	6.0	8.4	7.0	6.0	5.8
41.0	14.0	11.0	4.6	3.0	11.0	8.9
44.0	11.0	8.2	5.7	10.0	7.0	7.8
44.2	10.8	9.8	9.0	3.2	3.0	4.9
48.0	7.0	7.0	12.8	6.8	3.0	3.8
42.0	13.0	12.6	6.7	2.0	8.0	6.3
47.6	7.4	7.4	7.8	11.6	6.0	6.1
49.0	6.0	6.0	8.1	7.4	6.0	6.0
50.0	5.0	5.0	9.2	6.0	5.0	5.4
47.0	8.0	8.0	9.1	2.0	5.0	5.2
51.0	4.0	4.0	11.4	8.0	4.0	4.5
47.0	8.0	8.0	7.1	4.0	8.0	6.6
42.0	13.0	13.0	4.0	8.0	13.0	10.4
48.0	7.0	7.0	5.7	13.0	7.0	8.4
48.0	7.0	7.0	6.4	7.0	7.0	7.5
46.0	9.0	9.0	5.5	7.0	9.0	8.4
46.0	9.0	9.0	5.2	9.0	9.0	8.8
41.0	14.0	13.4	4.1	6.0	11.0	10.1
45.4	9.6	8.9	5.5	11.4	7.0	8.2
46.3	8.7	8.5	5.7	8.9	8.0	8.1
37.8	17.2	15.8	3.4	4.5	13.0	11.0
48.6	6.4	6.4	6.5	15.8	5.0	7.4
43.0	12.0	12.0	4.2	6.4	12.0	10.2
44.0	11.0	11.0	4.1	12.0	11.0	10.7
45.0	10.0	10.0	5.0	9.0	8.0	9.1
46.0	9.0	9.0	5.5	9.0	8.0	8.4
38.0	17.0	12.4	4.1	2.0	10.0	9.4
44.4	10.6	10.6	6.0	12.4	6.0	7.3
46.0	9.0	9.0	5.5	10.6	9.0	8.3
46.0	9.0	9.0	6.6	6.0	6.0	6.9
39.0	16.0	15.3	3.5	7.0	14.0	11.2
39.8	15.2	15.2	3.4	12.8	12.0	11.7

QS	QR	X	P	Y	Z	CP
48.0	7.0	7.0	5.4	15.2	7.0	8.9
41.0	14.0	8.7	5.3	0.	7.0	7.7
40.7	14.3	10.2	4.8	8.7	9.0	8.5
39.9	15.1	13.4	4.0	10.2	11.0	10.0
43.2	11.8	11.6	4.6	12.4	9.0	9.4
49.8	5.2	5.2	7.4	11.6	5.0	6.8
45.0	10.0	8.7	5.6	4.2	9.0	8.1
38.7	16.3	15.6	3.5	6.7	13.0	11.0
49.3	5.7	5.7	6.7	15.6	5.0	7.4
47.0	8.0	8.0	6.1	5.7	8.0	7.8
43.0	12.0	7.4	5.9	3.0	7.0	7.3
41.4	13.6	9.7	5.0	7.4	9.0	8.3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QR=5.
CP=5.
ALPHS=.6
QLAMDA=8.
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QS
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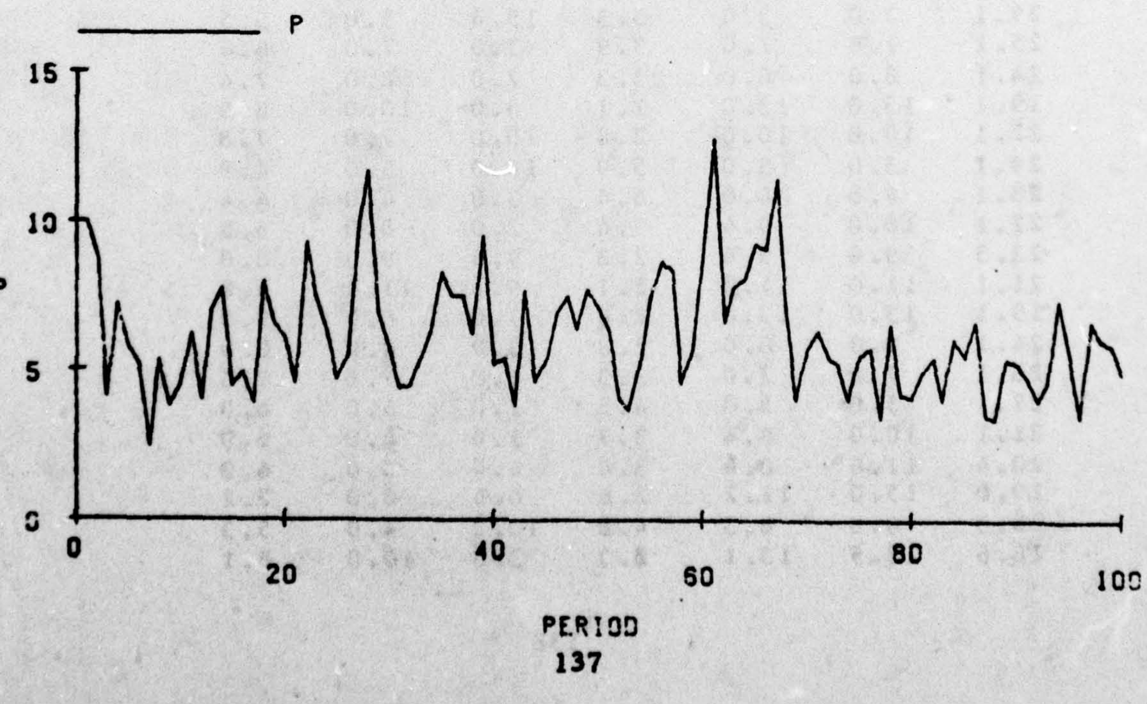
40
20
0
QS
QR
0
20
40
60
80
100
PERIOD


P
15
10
5
0
P
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

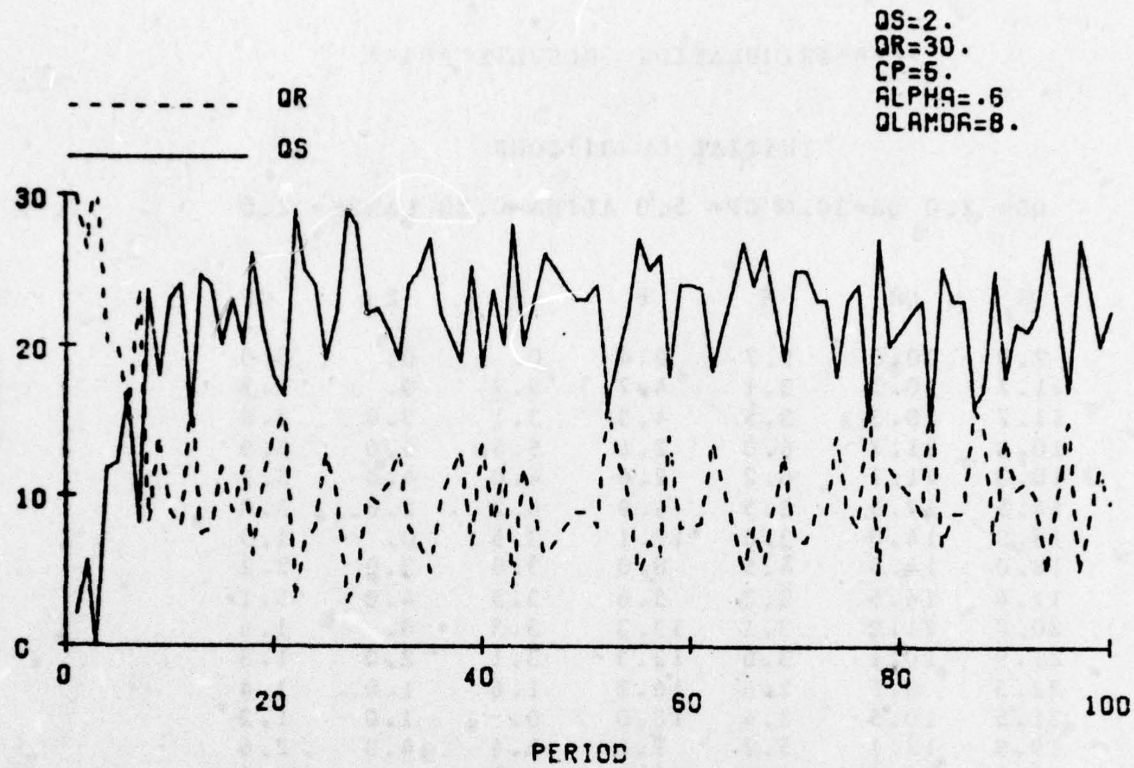
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.60 LAMDA= 8.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
5.7	26.3	10.3	1.0	9.7	6.0	5.6
0.	32.1	18.9	0.	6.3	12.0	9.4
11.9	20.2	10.4	1.9	15.9	4.0	6.2
12.3	19.8	13.7	1.6	9.4	9.0	7.9
17.0	15.1	14.3	2.0	13.7	9.0	8.5
8.2	23.9	23.5	0.7	6.3	15.0	12.4
23.7	8.4	8.4	3.0	20.5	5.0	8.0
18.1	14.0	14.0	1.8	5.4	11.0	9.8
23.1	9.0	9.0	2.5	14.0	9.0	9.3
24.1	8.0	8.0	3.3	7.0	6.0	7.3
15.1	17.0	16.5	1.6	2.0	11.0	9.5
24.6	7.5	7.5	4.0	13.5	4.0	6.2
24.1	8.0	8.0	4.0	5.5	6.0	6.1
20.1	12.0	12.0	2.1	8.0	12.0	9.6
23.1	9.0	9.0	2.5	12.0	9.0	9.3
20.1	12.0	12.0	1.8	9.0	12.0	10.9
26.1	6.0	6.0	4.2	9.0	3.0	6.2
21.1	11.0	9.8	3.2	2.0	7.0	6.7
17.9	14.2	10.7	2.6	3.8	7.0	6.9
16.6	15.4	15.4	1.8	9.7	11.0	9.3
29.1	3.0	3.0	5.3	15.4	3.0	5.5
25.1	7.0	7.0	3.9	3.0	7.0	6.4
24.1	8.0	8.0	3.3	7.0	8.0	7.4
19.1	13.0	13.0	2.1	5.0	10.0	8.9
22.1	10.0	10.0	2.8	10.0	7.0	7.8
29.1	3.0	3.0	5.9	10.0	3.0	4.9
28.1	4.0	4.0	6.4	3.0	4.0	4.4
22.1	10.0	9.4	3.4	2.0	8.0	6.5
22.5	9.6	9.6	2.8	9.4	9.0	8.0
21.1	11.0	11.0	2.1	9.6	11.0	9.8
19.1	13.0	13.0	2.0	7.0	9.0	9.3
24.1	8.0	8.0	2.8	13.0	8.0	8.5
25.1	7.0	7.0	3.3	8.0	7.0	7.6
27.1	5.0	5.0	4.5	7.0	5.0	6.0
22.1	10.0	8.4	3.7	1.0	6.0	6.0
20.4	11.6	8.6	3.4	4.4	6.0	6.0
19.0	13.0	11.2	2.6	6.6	8.0	7.2
25.3	6.8	6.3	4.8	10.2	4.0	5.3
18.6	13.5	13.1	2.3	3.3	10.0	8.1

QS	QR	X	P	Y	Z	CP
23.7	8.3	8.3	3.0	13.1	8.0	8.0
20.1	12.0	12.0	1.9	8.3	12.0	10.4
28.1	4.0	4.0	4.3	12.0	4.0	6.6
20.1	12.0	12.0	2.2	3.0	11.0	9.2
23.1	9.0	9.0	2.7	11.0	8.0	8.5
26.1	6.0	6.0	3.7	9.0	6.0	7.0
25.1	7.0	7.0	3.9	5.0	6.0	6.4
24.1	8.0	8.0	3.3	7.0	8.0	7.4
23.1	9.0	8.0	3.9	4.0	5.0	5.9
23.1	9.0	9.0	3.5	7.0	7.0	6.6
24.1	8.0	8.0	3.2	9.0	8.0	7.4
16.1	16.0	16.0	1.7	3.0	11.0	9.6
19.1	13.0	13.0	1.8	14.0	11.0	10.4
22.1	10.0	10.0	2.6	10.0	7.0	8.4
27.1	5.0	5.0	4.3	10.0	5.0	6.3
25.1	7.0	6.9	4.5	3.0	5.0	5.5
26.0	6.1	6.1	4.5	6.9	6.0	5.8
18.1	14.0	14.0	2.0	3.1	11.0	8.9
24.1	8.0	8.0	3.1	13.0	7.0	7.8
24.1	8.0	5.8	4.9	3.0	3.0	4.9
23.9	8.2	7.5	6.3	2.8	3.0	3.8
18.4	13.7	9.5	2.9	2.5	8.0	6.3
21.0	11.1	8.8	3.4	8.5	6.0	6.1
23.7	8.4	8.1	3.9	8.8	6.0	6.0
26.9	5.2	5.2	5.0	8.1	5.0	5.4
24.1	8.0	6.3	4.7	2.2	5.0	5.2
26.4	5.7	4.5	5.9	6.3	4.0	4.5
22.9	9.1	9.1	3.5	4.5	8.0	6.6
19.1	13.0	13.0	1.8	9.1	13.0	10.4
25.1	7.0	7.0	3.0	13.0	7.0	8.4
25.1	7.0	7.0	3.3	7.0	7.0	7.5
23.1	9.0	9.0	2.7	7.0	9.0	8.4
23.1	9.0	9.0	2.6	9.0	9.0	8.8
18.1	14.0	14.0	1.8	6.0	11.0	10.1
23.1	9.0	9.0	2.8	12.0	7.0	8.2
24.1	8.0	8.0	3.0	9.0	8.0	8.1
15.1	17.0	17.0	1.4	4.0	13.0	11.0
27.1	5.0	5.0	3.7	17.0	5.0	7.4
20.1	12.0	12.0	2.0	5.0	12.0	10.2
21.1	11.0	11.0	2.0	12.0	11.0	10.7
22.1	10.0	10.0	2.4	9.0	8.0	9.1
23.1	9.0	9.0	2.7	9.0	8.0	8.4
15.1	17.0	16.2	1.6	2.0	10.0	9.4
25.3	6.8	6.8	3.4	16.2	6.0	7.3
23.1	9.0	9.0	2.8	6.8	9.0	8.3
23.1	9.0	9.0	3.3	6.0	6.0	6.9
16.1	16.0	16.0	1.4	7.0	14.0	11.2
17.1	15.0	15.0	1.5	13.0	12.0	11.7

QS	QR	X	P	Y	Z	CP
25.1	7.0	7.0	2.8	15.0	7.0	8.9
18.1	14.0	12.5	2.3	0.	7.0	7.7
21.6	10.5	10.5	2.5	12.5	9.0	8.5
21.1	11.0	11.0	2.1	10.5	11.0	10.0
22.1	10.0	10.0	2.3	10.0	9.0	9.4
27.1	5.0	5.0	4.0	10.0	5.0	6.8
22.1	10.0	10.0	2.7	4.0	9.0	8.1
17.1	15.0	15.0	1.5	8.0	13.0	11.0
27.1	5.0	5.0	3.7	15.0	5.0	7.4
24.1	8.0	8.0	3.1	5.0	8.0	7.8
20.1	12.0	11.3	2.7	3.0	7.0	7.3
22.3	9.7	9.7	2.7	11.3	9.0	8.3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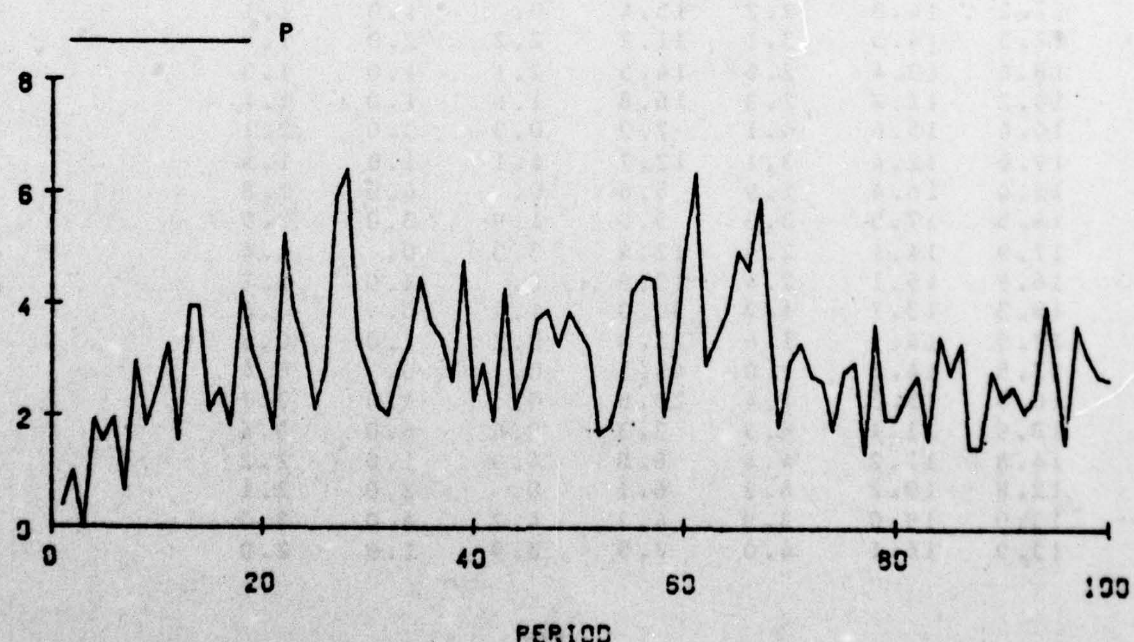
QR=30.
CP=5.
ALPHA=.6
QLAMDA=8.
QR
QS
QS QR
30
20
10
0
0
20
40
60
80
100
PERIOD


P
P
8
6
4
2
0
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

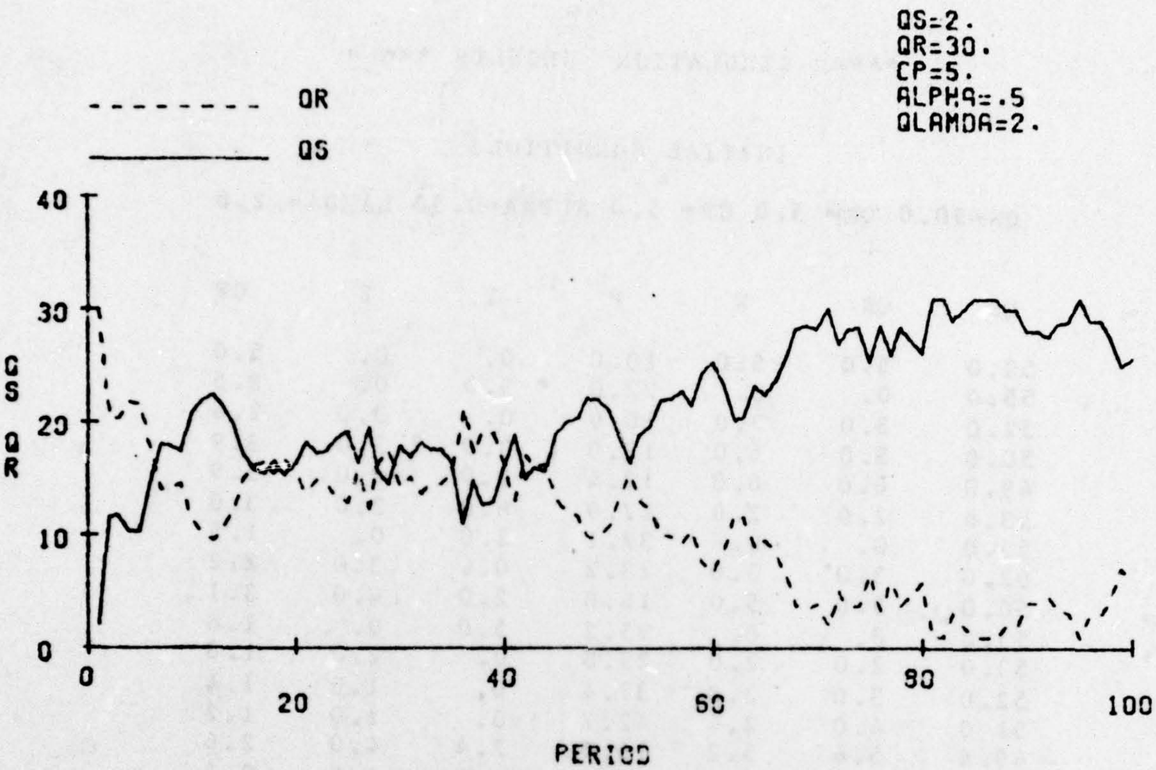
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.50 LAMDA= 2.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
11.7	20.3	3.1	4.7	9.7	0.	2.5
11.7	20.3	3.5	4.3	3.1	3.0	2.8
10.3	21.7	6.0	2.6	3.5	5.0	3.9
10.3	21.7	6.2	2.6	4.0	4.0	3.9
14.5	17.5	3.5	4.9	6.2	2.0	3.0
18.0	14.0	3.0	12.1	3.5	0.	1.5
18.0	14.0	4.5	8.0	3.0	3.0	2.2
17.4	14.6	3.3	5.6	3.5	4.0	3.1
20.8	11.2	3.1	13.3	3.3	0.	1.6
21.9	10.1	3.6	12.3	3.1	2.0	1.3
22.5	9.5	2.8	16.2	1.6	1.0	1.4
21.5	10.5	2.4	18.0	0.	1.0	1.2
19.9	12.1	5.2	7.6	2.4	4.0	2.6
17.0	15.0	3.3	5.2	1.2	4.0	3.3
15.8	16.2	4.7	4.3	2.8	4.0	3.6
15.5	16.5	3.1	5.5	1.7	2.0	2.8
16.5	15.5	3.8	8.6	2.1	1.0	1.9
15.4	16.6	3.9	7.9	0.8	2.0	2.0
16.3	15.7	5.0	6.6	3.9	3.0	2.5
18.2	13.8	2.5	14.7	2.0	0.	1.2
17.2	14.8	2.2	15.4	0.	1.0	1.1
17.5	14.5	3.1	11.2	2.2	2.0	1.6
18.6	13.4	2.6	14.5	2.1	1.0	1.3
19.2	12.8	2.3	16.8	1.6	1.0	1.1
16.4	15.6	4.1	7.9	0.3	3.0	2.1
19.6	12.4	3.1	12.7	4.1	1.0	1.5
15.6	16.4	2.9	5.6	0.	4.0	2.8
14.5	17.5	3.3	5.0	1.9	3.0	2.9
17.9	14.1	2.9	12.4	3.3	0.	1.4
16.9	15.1	2.4	13.8	0.	1.0	1.2
18.3	13.7	1.2	30.0	1.4	0.	0.6
17.5	14.5	1.6	21.8	0.2	1.0	0.8
17.5	14.5	1.0	43.5	0.	0.	0.4
16.5	15.5	1.4	23.6	0.	1.0	0.7
10.9	21.1	4.9	3.3	0.4	6.0	3.4
14.8	17.2	4.4	6.8	4.9	1.0	2.2
12.8	19.2	4.2	6.1	0.	2.0	2.1
13.0	19.0	3.9	4.3	4.2	4.0	3.0
15.9	16.1	4.0	7.9	3.9	1.0	2.0

QS	QR	X	P	Y	Z	CP
18.9	13.1	3.0	12.5	4.0	1.0	1.5
14.9	17.1	3.0	5.4	0.	4.0	2.8
16.0	16.0	3.8	8.5	2.0	1.0	1.9
15.7	16.3	3.3	5.4	3.8	4.0	2.9
19.0	13.0	2.9	12.9	3.3	0.	1.5
19.9	12.1	3.5	11.5	2.9	2.0	1.7
20.4	11.6	2.7	14.9	1.5	1.0	1.4
22.1	9.9	2.4	18.7	2.7	1.0	1.2
22.1	9.9	1.2	37.4	0.	0.	0.6
21.1	10.9	1.6	26.5	0.	1.0	0.8
18.7	13.3	4.8	7.8	1.6	4.0	2.4
16.5	15.5	5.4	6.1	0.8	3.0	2.7
18.9	13.1	4.7	8.0	4.4	2.0	2.3
19.6	12.4	2.3	16.7	0.7	0.	1.2
22.0	10.0	1.2	37.4	2.3	0.	0.6
22.1	9.9	1.6	27.9	1.2	1.0	0.8
22.7	9.3	1.8	25.3	1.6	1.0	0.9
21.5	10.5	3.9	11.0	1.8	3.0	1.9
24.4	7.6	2.9	16.6	3.9	1.0	1.5
25.4	6.6	1.5	34.4	0.9	0.	0.7
23.4	8.6	2.7	17.1	0.	2.0	1.4
20.1	11.9	5.4	7.5	0.7	4.0	2.7
20.5	11.5	4.7	8.7	2.4	2.0	2.3
23.1	8.9	4.3	10.7	4.7	2.0	2.2
22.5	9.5	4.2	10.8	1.3	2.0	2.1
23.7	8.3	3.1	15.3	2.2	1.0	1.5
25.7	6.3	2.5	20.3	3.1	1.0	1.3
28.3	3.7	1.3	44.5	2.5	0.	0.6
28.6	3.4	1.6	34.9	1.3	1.0	0.8
28.2	3.8	2.8	20.0	1.6	2.0	1.4
30.0	2.0	2.0	24.9	2.8	1.0	1.2
27.0	5.0	4.2	12.9	0.	3.0	2.1
28.2	3.8	3.1	18.2	2.2	1.0	1.6
28.3	3.7	3.7	12.4	3.1	3.0	2.3
25.3	6.7	5.3	9.6	0.	3.0	2.6
28.6	3.4	3.4	12.3	5.3	2.0	2.3
26.0	6.0	5.3	9.8	0.4	3.0	2.7
28.3	3.7	3.7	10.0	5.3	3.0	2.8
27.3	4.7	3.8	14.3	0.	1.0	1.9
26.1	5.9	5.9	7.6	3.8	5.0	3.5
31.0	1.0	1.0	13.9	5.9	1.0	2.2
31.0	1.0	1.0	27.8	0.	0.	1.1
29.0	3.0	3.0	18.6	0.	2.0	1.6
30.0	2.0	2.0	23.5	2.0	1.0	1.3
31.0	1.0	1.0	27.2	2.0	1.0	1.1
31.0	1.0	1.0	29.0	1.0	1.0	1.1
31.0	1.0	1.0	30.0	1.0	1.0	1.0
30.0	2.0	2.0	29.5	0.	1.0	1.0

QS	QR	X	P	Y	Z	CP
30.0	2.0	2.0	29.7	1.0	1.0	1.0
28.0	4.0	3.0	18.6	0.	2.0	1.5
28.0	4.0	2.5	22.4	1.0	1.0	1.3
27.5	4.5	4.3	12.9	2.5	3.0	2.1
28.8	3.2	2.1	27.1	1.3	0.	1.1
28.9	3.1	3.1	18.9	2.1	2.0	1.5
31.0	1.0	1.0	24.5	3.1	1.0	1.3
29.0	3.0	3.0	17.7	0.	2.0	1.6
29.0	3.0	2.6	22.0	1.0	1.0	1.3
27.6	4.4	3.3	16.7	0.6	2.0	1.7
24.9	7.1	4.7	10.7	0.3	3.0	2.3
25.6	6.4	4.3	11.8	2.7	2.0	2.2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CP=5.
ALPHA=.5
QLAMDA=2.
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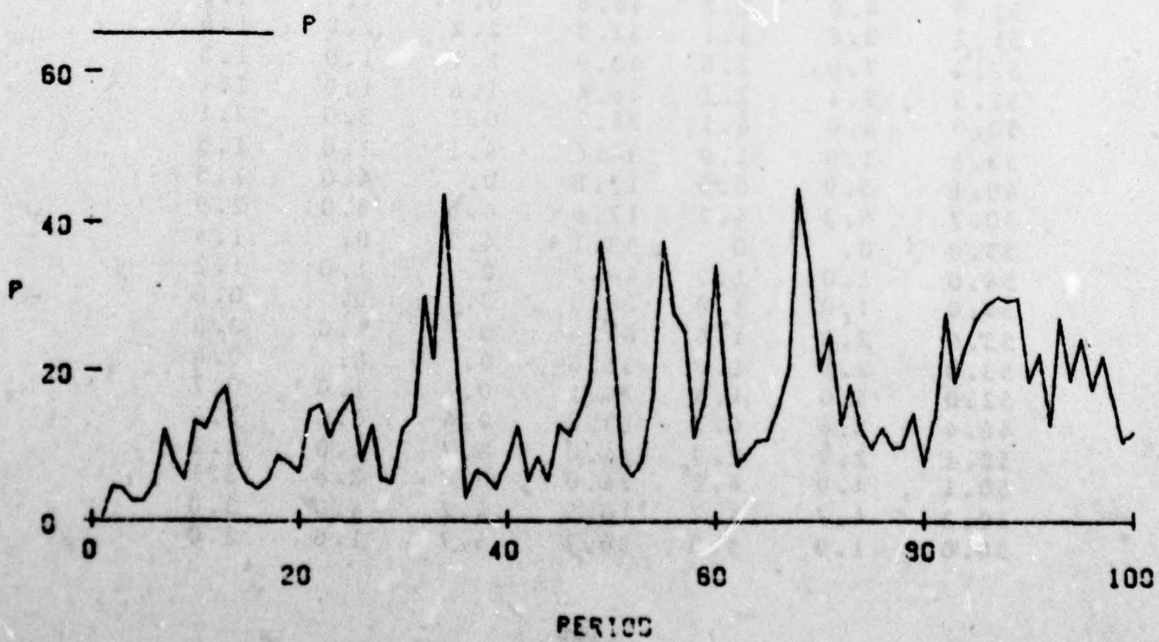
QS
QS
QR
PERIOD


P
P
PERIOD

***** SIMULATION RESULTS *****

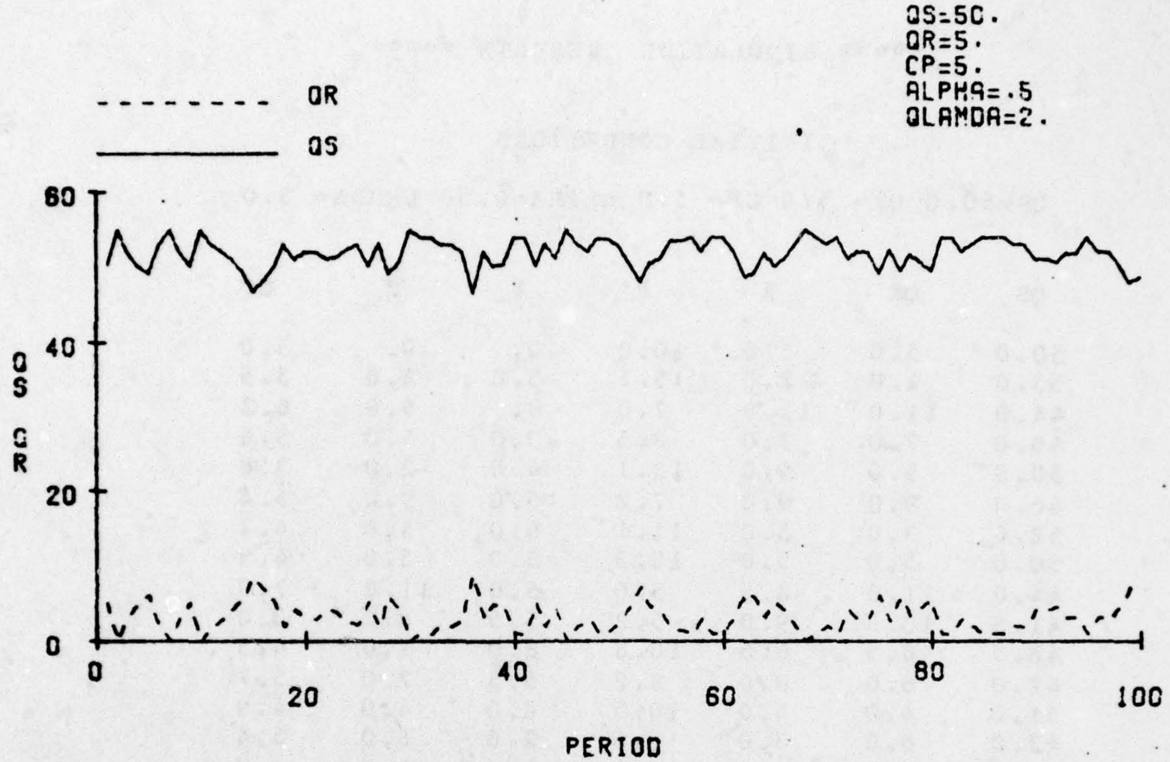
INITIAL CONDITIONS

QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.50 LAMDA= 2.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
55.0	0.	0.	22.0	5.0	0.	2.5
52.0	3.0	3.0	18.9	0.	3.0	2.8
50.0	5.0	5.0	12.9	3.0	5.0	3.9
49.0	6.0	6.0	12.4	3.0	4.0	3.9
53.0	2.0	2.0	17.9	6.0	2.0	3.0
55.0	0.	0.	37.1	2.0	0.	1.5
52.0	3.0	3.0	23.2	0.	3.0	2.2
50.0	5.0	5.0	16.0	2.0	4.0	3.1
55.0	0.	0.	35.2	5.0	0.	1.6
53.0	2.0	2.0	29.8	0.	2.0	1.8
52.0	3.0	2.8	37.4	0.	1.0	1.4
51.0	4.0	2.4	42.7	0.	1.0	1.2
49.4	5.6	5.2	19.0	2.4	4.0	2.6
46.6	8.4	6.6	14.1	1.2	4.0	3.3
48.2	6.8	6.8	13.2	5.6	4.0	3.6
50.0	5.0	5.0	17.7	3.8	2.0	2.8
53.0	2.0	2.0	27.7	4.0	1.0	1.9
51.0	4.0	3.9	26.1	0.	2.0	2.0
51.9	3.1	3.1	20.9	3.9	3.0	2.5
52.0	3.0	2.5	42.0	0.1	0.	1.2
51.0	4.0	2.2	45.6	0.	1.0	1.1
51.2	3.8	3.1	32.9	2.2	2.0	1.6
52.4	2.6	2.6	40.9	2.1	1.0	1.3
52.9	2.1	2.1	46.4	1.6	1.0	1.1
50.0	5.0	4.1	24.2	0.1	3.0	2.1
53.1	1.9	1.9	34.6	4.1	1.0	1.5
49.1	5.9	5.5	17.8	0.	4.0	2.8
50.7	4.3	4.3	17.6	4.5	3.0	2.9
55.0	0.	0.	38.1	4.3	0.	1.4
54.0	1.0	1.0	44.2	0.	1.0	1.2
54.0	1.0	1.0	88.5	0.	0.	0.6
53.0	2.0	1.6	65.8	0.	1.0	0.8
53.0	2.0	1.0	31.6	0.	0.	0.4
52.0	3.0	1.4	74.1	0.	1.0	0.7
46.4	8.6	6.7	13.8	0.4	6.0	3.4
52.1	2.9	2.9	24.0	6.7	1.0	2.2
50.1	4.9	4.2	24.0	0.	2.0	2.1
50.3	4.7	4.7	16.5	4.2	4.0	3.0
54.0	1.0	1.0	26.7	4.7	1.0	2.0

QS	QR	X	P	Y	Z	CP
54.0	1.0	1.0	35.7	1.0	1.0	1.5
50.0	5.0	5.0	18.1	0.	4.0	2.8
53.0	2.0	2.0	28.2	4.0	1.0	1.9
51.0	4.0	4.0	17.4	2.0	4.0	2.9
55.0	0.	0.	37.4	4.0	0.	1.5
53.0	2.0	2.0	30.6	0.	2.0	1.7
52.0	3.0	2.7	38.0	0.	1.0	1.4
53.7	1.3	1.3	45.4	2.7	1.0	1.2
53.7	1.3	1.2	90.8	0.	0.	0.6
52.7	2.3	1.6	66.3	0.	1.0	0.8
50.3	4.7	4.7	21.0	1.6	4.0	2.4
48.0	7.0	5.4	17.8	0.7	3.0	2.7
50.4	4.6	4.6	21.5	4.4	2.0	2.3
51.0	4.0	2.3	43.4	0.6	0.	1.2
53.3	1.7	1.2	90.8	2.3	0.	0.6
53.5	1.5	1.5	67.4	1.2	1.0	0.8
54.0	1.0	1.0	60.2	1.5	1.0	0.9
52.0	3.0	3.0	26.7	1.0	3.0	1.9
54.0	1.0	1.0	36.6	3.0	1.0	1.5
54.0	1.0	1.0	73.3	0.	0.	0.7
52.0	3.0	2.7	38.0	0.	2.0	1.4
48.7	6.3	5.4	18.2	0.7	4.0	2.7
49.1	5.9	4.7	21.0	2.4	2.0	2.3
51.8	3.2	3.2	23.9	4.7	2.0	2.2
50.0	5.0	4.2	24.0	0.2	2.0	2.1
51.2	3.8	3.1	33.2	2.2	1.0	1.5
53.3	1.7	1.7	41.9	3.1	1.0	1.3
55.0	0.	0.	86.5	1.7	0.	0.6
54.0	1.0	1.0	66.0	0.	1.0	0.8
53.0	2.0	2.0	37.6	1.0	2.0	1.4
54.0	1.0	1.0	44.8	2.0	1.0	1.2
51.0	4.0	4.0	24.3	0.	3.0	2.1
52.0	3.0	3.0	33.5	2.0	1.0	1.6
52.0	3.0	3.0	22.9	3.0	3.0	2.3
49.0	6.0	5.3	18.6	0.	3.0	2.6
52.3	2.7	2.7	22.5	5.3	2.0	2.3
49.3	5.7	5.3	18.5	0.	3.0	2.7
51.6	3.4	3.4	13.2	5.3	3.0	2.8
50.6	4.4	3.8	26.4	0.	1.0	1.9
49.4	5.6	5.6	14.3	3.8	5.0	3.5
54.0	1.0	1.0	24.2	5.6	1.0	2.2
54.0	1.0	1.0	48.5	0.	0.	1.1
52.0	3.0	3.0	33.4	0.	2.0	1.6
53.0	2.0	2.0	41.5	2.0	1.0	1.3
54.0	1.0	1.0	47.4	2.0	1.0	1.1
54.0	1.0	1.0	50.5	1.0	1.0	1.1
54.0	1.0	1.0	52.2	1.0	1.0	1.0
53.0	2.0	2.0	52.1	0.	1.0	1.0

QS	QR	X	P	Y	Z	CP
53.0	2.0	2.0	52.5	1.0	1.0	1.0
51.0	4.0	3.0	33.9	0.	2.0	1.5
51.0	4.0	2.5	40.7	1.0	1.0	1.3
50.5	4.5	4.3	23.8	2.5	3.0	2.1
51.8	3.2	2.1	48.7	1.3	0.	1.1
51.9	3.1	3.1	33.9	2.1	2.0	1.5
54.0	1.0	1.0	42.6	3.1	1.0	1.3
52.0	3.0	3.0	31.8	0.	2.0	1.6
52.0	3.0	2.6	39.5	1.0	1.0	1.3
50.6	4.4	3.3	30.5	0.6	2.0	1.7
47.9	7.1	4.7	20.6	0.3	3.0	2.3
48.6	6.4	4.3	22.5	2.7	2.0	2.2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QR=5.
CP=5.
ALPHA=.5
QLAMDA=2.
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QS
Q
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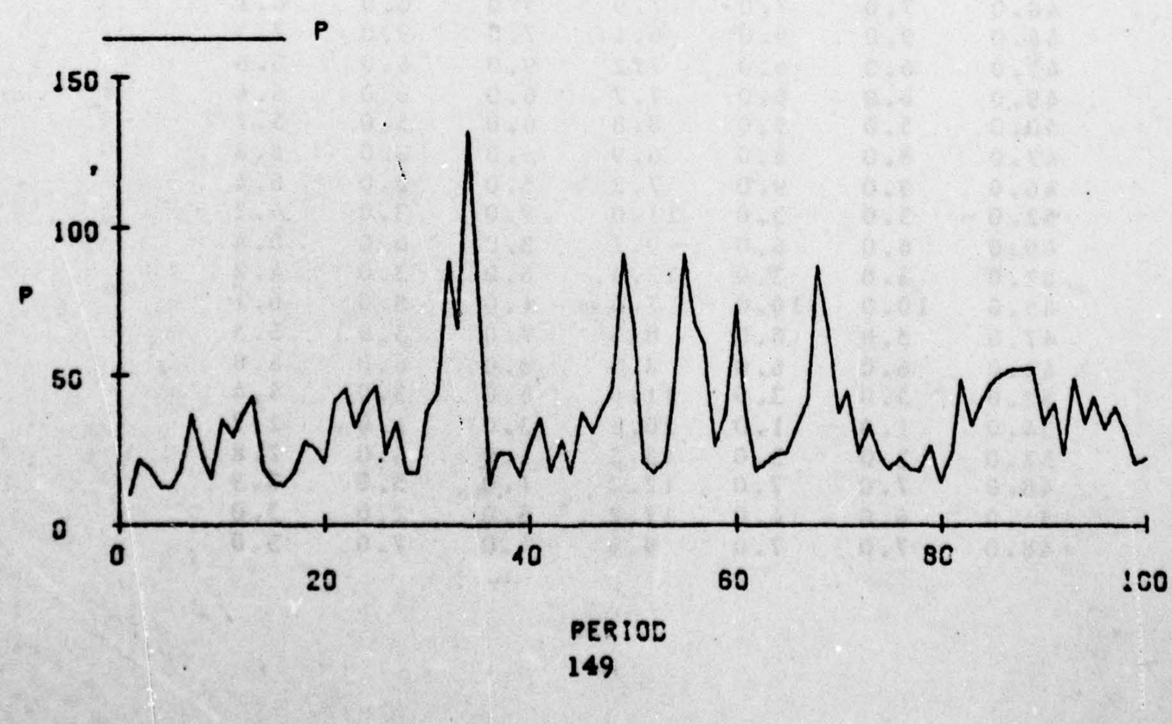
Q
R
0
20
40
60
0
20
40
60
80
100
PERIOD


P
P
0
50
100
150
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

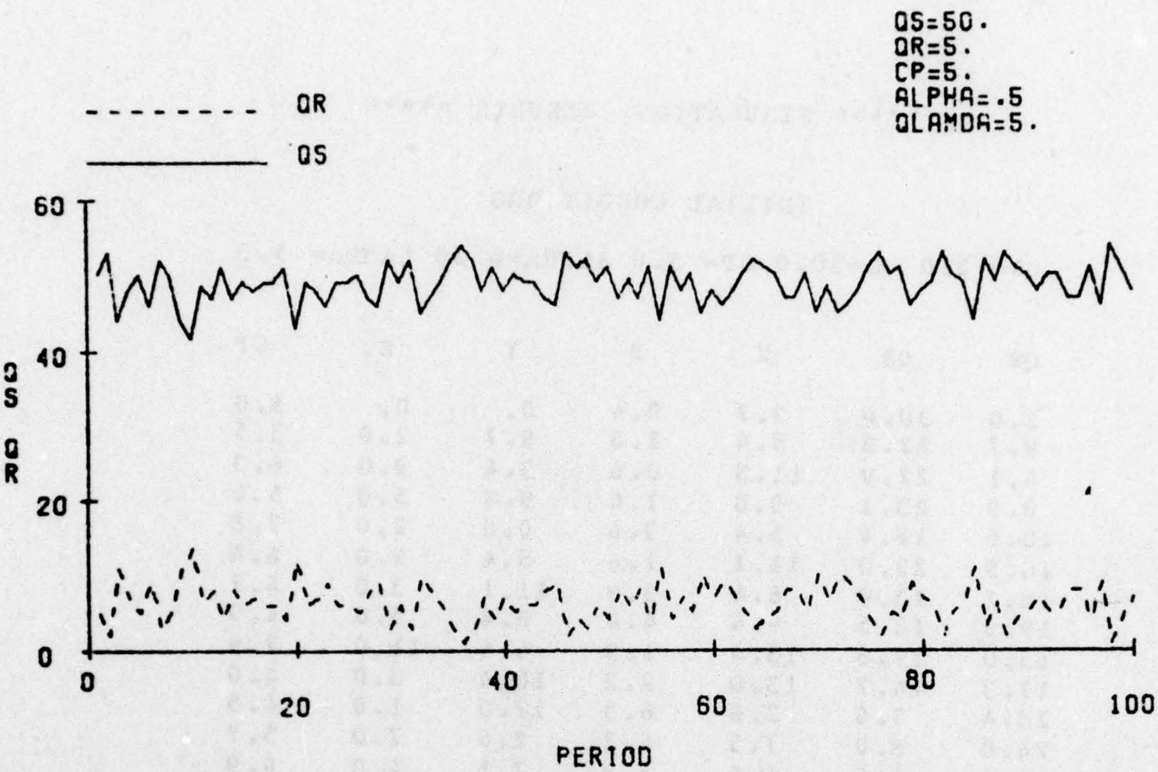
INITIAL CONDITIONS

QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.50 LAMDA= 5.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
53.0	2.0	2.0	15.1	5.0	2.0	3.5
44.0	11.0	11.0	7.0	0.	9.0	6.3
48.0	7.0	7.0	8.5	9.0	5.0	5.6
50.0	5.0	5.0	13.1	4.0	2.0	3.8
46.0	9.0	9.0	7.2	5.0	9.0	6.4
52.0	3.0	3.0	11.1	9.0	3.0	4.7
50.0	5.0	5.0	10.3	3.0	5.0	4.9
44.0	11.0	8.5	5.6	5.0	11.0	7.9
41.5	13.5	9.0	5.2	5.5	8.0	8.0
48.5	6.5	6.5	10.8	8.0	1.0	4.5
47.0	8.0	8.0	8.2	5.5	7.0	5.7
51.0	4.0	4.0	10.5	8.0	4.0	4.9
47.0	8.0	8.0	8.6	2.0	6.0	5.4
49.0	6.0	6.0	10.4	6.0	4.0	4.7
48.0	7.0	7.0	9.0	5.0	6.0	5.4
49.0	6.0	6.0	9.5	6.0	5.0	5.2
49.0	6.0	6.0	12.0	3.0	3.0	4.1
51.0	4.0	4.0	14.4	5.0	3.0	3.5
43.0	12.0	12.0	6.9	1.0	9.0	6.3
49.0	6.0	6.0	8.0	12.0	6.0	6.1
48.0	7.0	7.0	7.9	5.0	6.0	6.1
46.0	9.0	9.0	6.1	7.0	9.0	7.5
49.0	6.0	6.0	7.2	9.0	6.0	6.8
49.0	6.0	6.0	7.7	6.0	6.0	6.4
50.0	5.0	5.0	8.8	6.0	5.0	5.7
47.0	8.0	8.0	6.9	5.0	8.0	6.8
46.0	9.0	9.0	7.2	5.0	6.0	6.4
52.0	3.0	3.0	11.0	9.0	3.0	4.7
49.0	6.0	6.0	9.1	3.0	6.0	5.4
52.0	3.0	3.0	12.4	6.0	3.0	4.2
45.0	10.0	10.0	7.4	1.0	8.0	6.1
47.0	8.0	8.0	8.5	7.0	5.0	5.5
49.0	6.0	6.0	8.5	8.0	6.0	5.8
52.0	3.0	3.0	11.9	6.0	3.0	4.4
54.0	1.0	1.0	20.1	3.0	1.0	2.7
52.0	3.0	3.0	18.3	1.0	3.0	2.8
48.0	7.0	7.0	12.2	1.0	5.0	3.9
51.0	4.0	4.0	17.2	5.0	2.0	3.0
48.0	7.0	7.0	9.6	4.0	7.0	5.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	7.0	5.0	5.0
49.0	6.0	6.0	9.8	4.0	5.0	5.0
49.0	6.0	6.0	14.0	2.0	2.0	3.5
47.0	8.0	8.0	9.0	5.0	7.0	5.2
46.0	9.0	9.0	9.9	3.0	4.0	4.6
53.0	2.0	2.0	18.8	8.0	1.0	2.8
51.0	4.0	4.0	15.0	2.0	4.0	3.4
52.0	3.0	3.0	16.2	4.0	3.0	3.2
49.0	6.0	6.0	10.6	3.0	6.0	4.6
51.0	4.0	4.0	15.5	4.0	2.0	3.3
47.0	8.0	7.3	12.9	0.	4.0	3.7
49.3	5.7	5.7	11.4	7.3	5.0	4.3
47.0	8.0	8.0	10.1	2.7	5.0	4.7
51.0	4.0	4.0	15.3	6.0	2.0	3.3
44.0	11.0	11.0	7.8	1.0	8.0	5.7
51.0	4.0	4.0	15.3	8.0	1.0	3.3
48.0	7.0	7.0	9.3	4.0	7.0	5.2
50.0	5.0	5.0	9.8	7.0	5.0	5.1
45.0	10.0	10.0	6.4	4.0	9.0	7.0
48.0	7.0	7.0	6.8	10.0	7.0	7.0
46.0	9.0	9.0	6.6	5.0	7.0	7.0
48.0	7.0	7.0	8.0	7.0	5.0	6.0
50.0	5.0	5.0	9.1	7.0	5.0	5.5
52.0	3.0	3.0	12.2	5.0	3.0	4.3
51.0	4.0	4.0	12.4	3.0	4.0	4.1
50.0	5.0	5.0	12.3	3.0	4.0	4.1
47.0	8.0	8.0	11.7	1.0	4.0	4.0
47.0	8.0	8.0	11.7	4.0	4.0	4.0
50.0	5.0	5.0	11.1	8.0	5.0	4.5
45.0	10.0	9.5	9.5	0.	5.0	4.8
48.5	6.5	6.5	9.0	9.5	6.0	5.4
45.0	10.0	10.0	7.3	3.5	7.0	6.2
46.0	9.0	9.0	6.1	10.0	9.0	7.6
48.0	7.0	7.0	8.3	6.0	4.0	5.8
51.0	4.0	4.0	11.6	6.0	3.0	4.4
53.0	2.0	2.0	16.6	4.0	2.0	3.2
50.0	5.0	5.0	12.2	2.0	5.0	4.1
51.0	4.0	4.0	14.4	4.0	3.0	3.5
46.0	9.0	9.0	9.6	1.0	6.0	4.8
48.0	7.0	7.0	8.2	9.0	7.0	5.9
49.0	6.0	6.0	9.0	6.0	5.0	5.4
53.0	2.0	2.0	14.2	6.0	2.0	3.7
50.0	5.0	5.0	13.0	1.0	4.0	3.9
49.0	6.0	6.0	9.9	5.0	6.0	4.9
44.0	11.0	10.9	8.1	1.0	6.0	5.5
51.9	3.1	3.1	12.3	10.9	3.0	4.2
49.0	6.0	6.0	13.5	0.1	3.0	3.6
53.0	2.0	2.0	23.0	5.0	1.0	2.3

QS	QR	X	P	Y	Z	CP
51.0	4.0	4.0	16.2	2.0	4.0	3.2
50.0	5.0	5.0	19.4	1.0	2.0	2.6
48.0	7.0	7.0	12.7	3.0	5.0	3.8
50.0	5.0	5.0	14.7	5.0	3.0	3.4
50.0	5.0	5.0	13.5	4.0	4.0	3.7
47.0	8.0	8.0	8.8	4.0	7.0	5.3
47.0	8.0	8.0	8.3	6.0	6.0	5.7
51.0	4.0	4.0	10.5	8.0	4.0	4.8
46.0	9.0	9.0	8.5	1.0	6.0	5.4
54.0	1.0	1.0	16.8	9.0	1.0	3.2
51.0	4.0	4.0	14.1	1.0	4.0	3.6
48.0	7.0	7.0	10.0	3.0	6.0	4.8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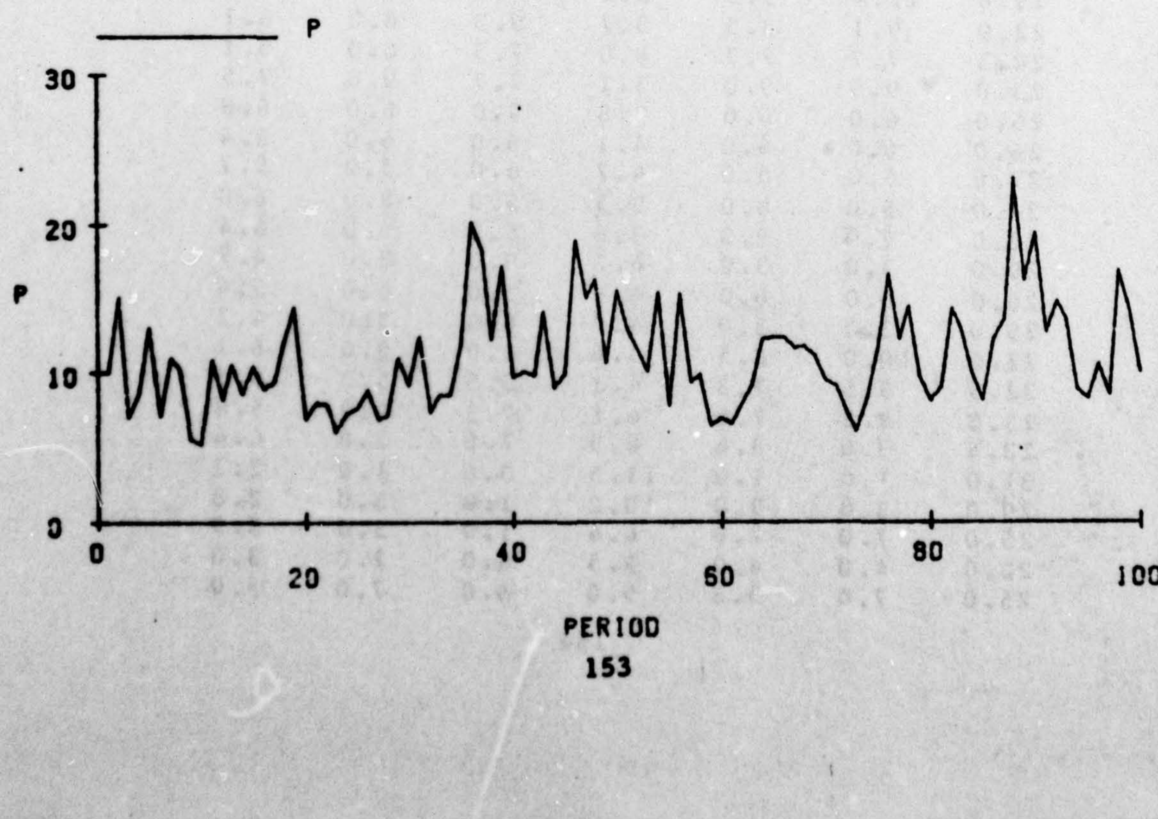
QR=5.
CP=5.
ALPHA=.5
QLAMDA=5.
QR
QS
QS QR
PERIOD


P
P
PERIOD

***** SIMULATION RESULTS *****

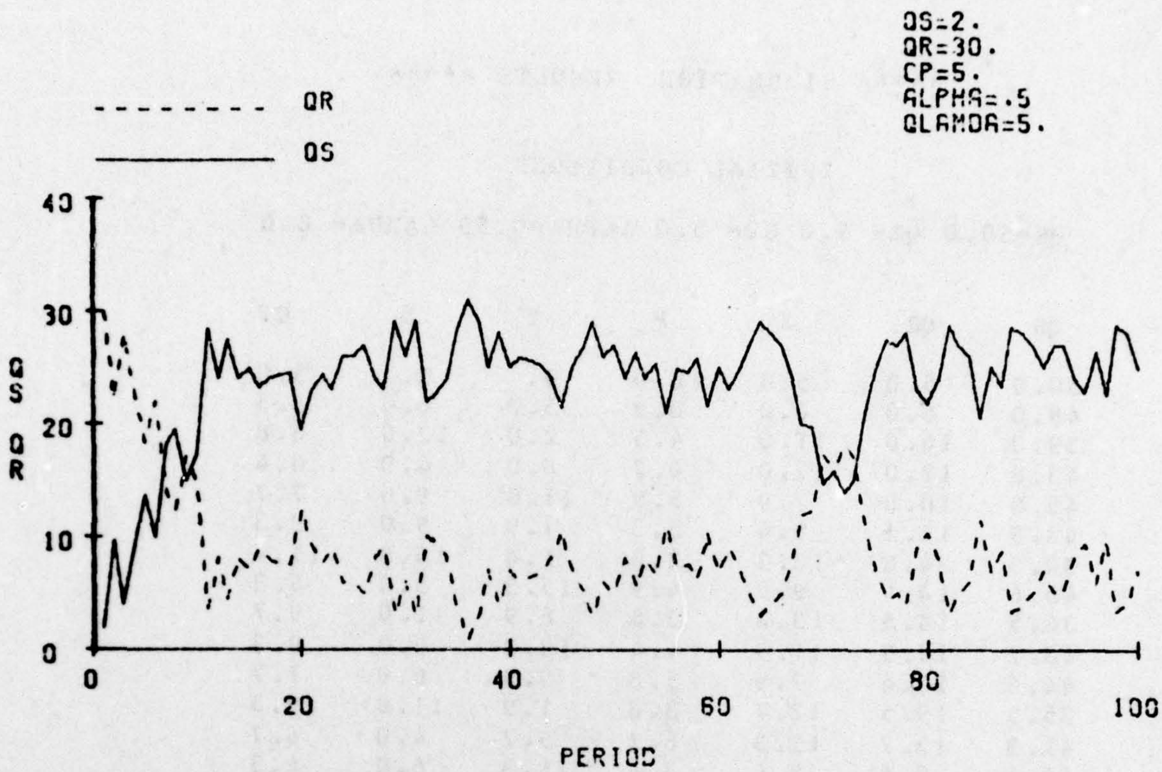
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.50 LAMDA= 5.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
9.7	22.3	5.4	2.3	9.7	2.0	3.5
4.1	27.9	11.8	0.6	3.4	9.0	6.3
8.9	23.1	9.8	1.6	9.8	5.0	5.6
13.6	18.4	5.4	3.6	6.8	2.0	3.8
10.0	22.0	11.1	1.6	5.4	9.0	6.4
18.1	13.9	6.4	3.9	11.1	3.0	4.7
19.5	12.5	6.4	4.0	6.4	5.0	4.9
15.0	17.0	13.4	1.9	6.4	11.0	7.9
17.3	14.7	13.0	2.2	10.4	8.0	8.0
28.4	3.6	3.6	6.3	12.0	1.0	4.5
24.0	8.0	7.5	4.2	2.6	7.0	5.7
27.5	4.5	4.5	5.6	7.5	4.0	4.9
24.0	8.0	6.9	4.4	2.5	6.0	5.4
24.9	7.1	5.3	5.3	4.9	4.0	4.7
23.2	8.8	6.9	4.3	4.3	6.0	5.4
24.0	8.0	6.4	4.6	5.9	5.0	5.2
24.4	7.6	4.1	6.0	3.4	3.0	4.1
24.5	7.5	7.1	6.9	3.1	3.0	3.5
19.6	12.4	9.3	3.1	4.1	9.0	6.3
22.9	9.1	8.5	3.7	9.3	6.0	6.1
24.3	7.7	7.7	4.0	7.5	6.0	6.1
23.0	9.0	9.0	3.1	7.7	9.0	7.5
26.0	6.0	6.0	3.8	9.0	6.0	6.8
26.0	6.0	6.0	4.1	6.0	6.0	6.4
27.0	5.0	5.0	4.7	6.0	5.0	5.7
24.0	8.0	8.0	3.5	5.0	8.0	6.3
23.0	9.0	9.0	3.6	5.0	6.0	6.4
29.0	3.0	3.0	6.2	9.0	3.0	4.7
26.0	6.0	6.0	4.9	3.0	6.0	5.4
29.0	3.0	3.0	6.9	6.0	3.0	4.2
22.0	10.0	8.5	3.6	1.0	8.0	6.1
22.5	9.5	7.3	4.1	5.5	5.0	5.5
23.8	8.2	7.6	4.1	7.3	6.0	5.8
28.4	3.6	3.6	6.5	7.6	3.0	4.4
31.0	1.0	1.0	11.5	3.6	1.0	2.7
29.0	3.0	3.0	10.2	1.0	3.0	2.8
25.0	7.0	7.0	6.4	1.0	5.0	3.9
28.0	4.0	4.0	9.5	5.0	2.0	3.0
25.0	7.0	5.8	5.0	4.0	7.0	5.0

QS	QR	X	P	Y	Z	CP
25.8	6.2	5.7	5.2	5.8	5.0	5.0
25.5	6.5	5.7	5.1	4.7	5.0	5.0
25.2	6.8	6.8	7.2	1.7	2.0	3.5
24.0	8.0	6.5	4.6	5.8	7.0	5.2
21.5	10.5	5.7	4.6	1.5	4.0	4.6
25.2	6.8	5.6	8.9	4.7	1.0	2.8
26.8	5.2	5.2	7.9	5.6	4.0	3.4
29.0	3.0	3.0	9.1	5.2	3.0	3.2
26.0	6.0	4.9	5.7	3.0	6.0	4.6
26.9	5.1	5.1	8.1	2.9	2.0	3.3
24.0	8.0	7.3	6.6	1.1	4.0	3.7
26.3	5.7	5.7	6.1	7.3	5.0	4.3
24.0	8.0	5.3	5.1	2.7	5.0	4.7
25.3	6.7	6.7	7.6	3.3	2.0	3.3
21.0	11.0	7.8	3.7	3.7	8.0	5.7
24.8	7.2	6.7	7.4	4.8	1.0	3.3
24.5	7.5	6.3	4.7	6.7	7.0	5.2
25.7	6.3	5.9	5.1	6.3	5.0	5.1
21.6	10.4	10.4	3.1	4.9	9.0	7.0
25.0	7.0	7.0	3.6	10.4	7.0	7.0
23.0	9.0	9.0	3.3	5.0	7.0	7.0
25.0	7.0	7.0	4.2	7.0	5.0	6.0
27.0	5.0	5.0	4.9	7.0	5.0	5.5
29.0	3.0	3.0	6.8	5.0	3.0	4.3
28.0	4.0	4.0	6.8	3.0	4.0	4.1
27.0	5.0	5.0	6.6	3.0	4.0	4.1
24.0	8.0	4.1	6.0	1.0	4.0	4.0
20.1	11.9	4.7	5.0	0.1	4.0	4.0
19.8	12.2	5.7	4.4	4.7	5.0	4.5
14.8	17.2	7.0	3.1	0.	5.0	4.8
15.8	16.2	8.1	2.9	7.0	6.0	5.4
13.9	18.1	10.1	2.2	5.1	7.0	6.2
15.0	17.0	12.7	2.0	10.1	9.0	7.6
20.7	11.3	8.1	3.6	9.7	4.0	5.8
24.8	7.2	4.7	5.6	7.1	3.0	4.4
27.5	4.5	4.5	8.6	4.7	2.0	3.2
27.0	5.0	5.0	6.6	4.5	5.0	4.1
28.0	4.0	4.0	7.9	4.0	3.0	3.5
23.0	9.0	5.7	4.8	1.0	6.0	4.8
21.7	10.3	8.2	3.7	5.7	7.0	5.9
23.9	8.1	6.9	4.4	7.2	5.0	5.4
28.8	3.2	3.2	7.7	6.9	2.0	3.7
27.0	5.0	5.0	7.0	2.2	4.0	3.9
26.0	6.0	5.5	5.3	5.0	6.0	4.9
20.5	11.5	7.5	3.8	0.5	6.0	5.5
25.0	7.0	4.3	5.9	7.5	3.0	4.2
23.3	8.7	7.2	6.5	1.3	3.0	3.6
28.6	3.4	3.4	12.4	6.2	1.0	2.3

QS	QR	X	P	Y	Z	CP
28.0	4.0	4.0	8.9	3.4	4.0	3.2
27.0	5.0	5.0	10.5	1.0	2.0	2.6
25.0	7.0	7.0	6.6	3.0	5.0	3.8
27.0	5.0	5.0	8.0	5.0	3.0	3.4
27.0	5.0	5.0	7.3	4.0	4.0	3.7
24.0	8.0	6.7	4.5	4.0	7.0	5.3
22.7	9.3	7.6	4.0	4.7	6.0	5.7
26.3	5.7	5.3	5.4	7.6	4.0	4.8
22.6	9.4	7.1	4.2	2.3	6.0	5.4
28.6	3.4	3.4	8.9	7.1	1.0	3.2
28.0	4.0	4.0	7.8	3.4	4.0	3.6
25.0	7.0	5.4	5.2	3.0	6.0	4.8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QR=30.
CP=5.
ALPHA=.5
QLAMDA=5.
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QS
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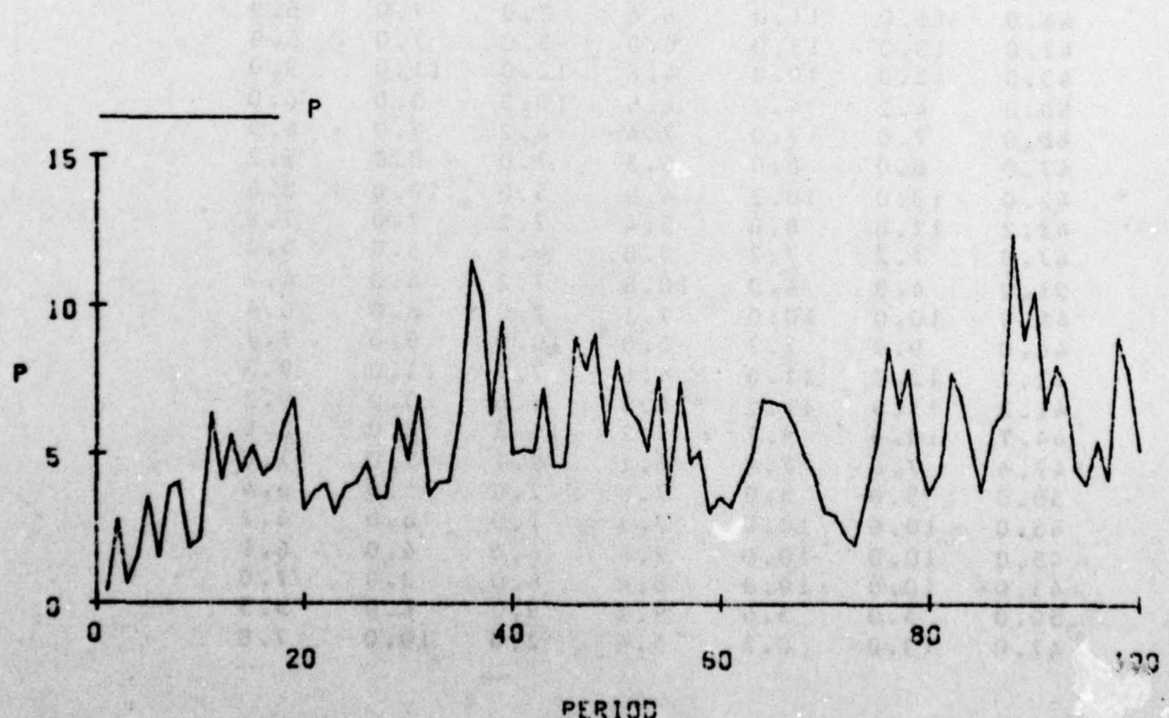
30
20
10
0
Q S Q R
0
20
40
60
80
100
PERIOD


P
15
10
5
0
P
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

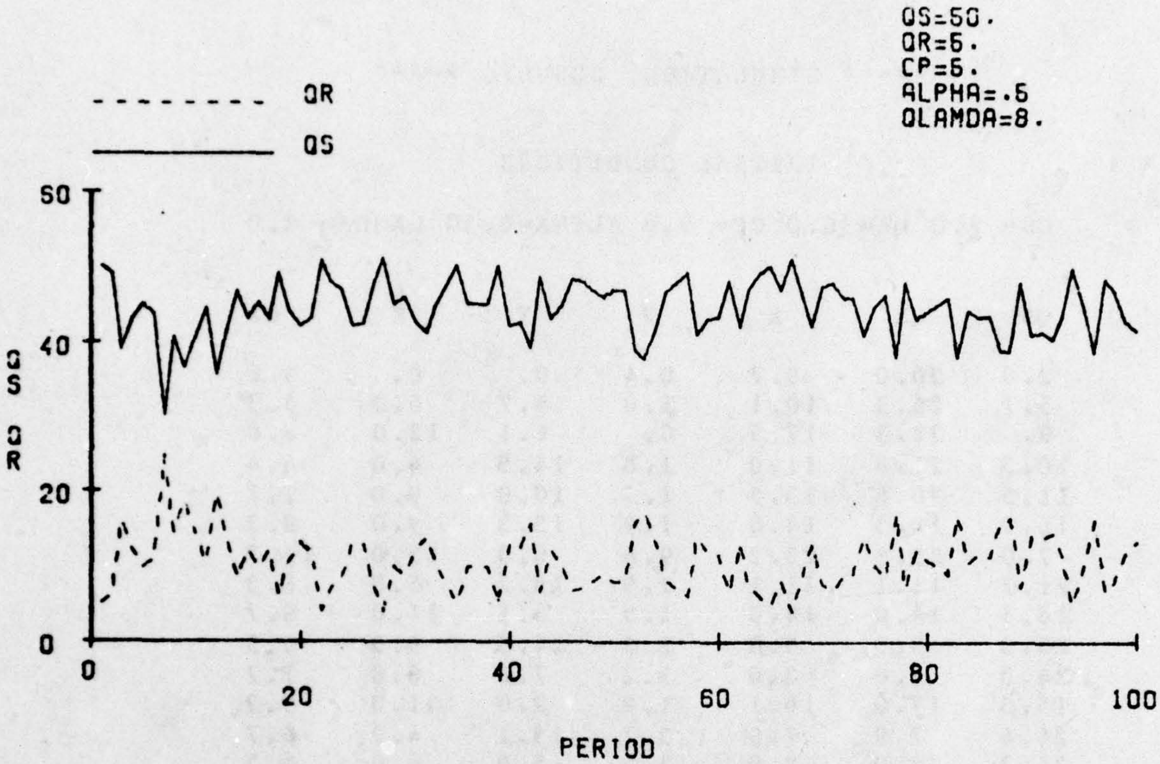
INITIAL CONDITIONS

QS=50.0 QR= 5.0 CP= 5.0 ALPHA=0.50 LAMDA= 8.0

QS	QR	X	P	Y	Z	CP
50.0	5.0	5.0	10.0	0.	0.	5.0
49.0	6.0	6.0	8.9	5.0	6.0	5.5
39.0	16.0	11.0	4.5	2.0	12.0	8.8
43.0	12.0	12.0	6.7	8.0	4.0	6.4
45.0	10.0	7.9	5.9	11.0	9.0	7.7
43.9	11.1	9.4	5.3	7.9	9.0	8.3
30.3	24.8	18.3	2.6	1.4	15.0	11.7
40.6	14.4	9.9	4.9	15.3	5.0	8.3
36.5	18.5	13.3	3.8	6.9	11.0	9.7
40.7	14.3	11.9	4.4	13.3	9.0	9.3
44.6	10.4	7.9	5.8	9.9	6.0	7.7
35.5	19.5	12.7	3.8	1.9	11.0	9.3
41.3	13.7	13.3	6.2	9.7	4.0	6.7
46.6	8.4	8.4	7.4	11.3	6.0	6.3
43.0	12.0	11.2	4.7	8.4	12.0	9.2
45.2	9.8	9.8	5.0	11.2	9.0	9.1
43.0	12.0	12.0	4.1	9.8	12.0	10.5
49.0	6.0	6.0	7.2	9.0	3.0	6.8
44.0	11.0	11.0	6.4	2.0	7.0	6.9
42.0	13.0	13.0	6.0	5.0	7.0	6.9
43.0	12.0	10.8	4.8	12.0	11.0	9.0
50.8	4.2	4.2	8.5	10.8	3.0	6.0
48.0	7.0	7.0	7.4	4.2	7.0	6.5
47.0	8.0	8.0	6.5	7.0	8.0	7.2
42.0	13.0	10.2	4.9	5.0	10.0	8.6
42.2	12.8	8.6	5.4	7.2	7.0	7.8
47.8	7.2	7.2	8.8	8.6	3.0	5.4
51.0	4.0	4.0	10.8	7.2	4.0	4.7
45.0	10.0	10.0	7.1	2.0	8.0	6.4
46.0	9.0	7.7	6.0	10.0	9.0	7.7
42.7	12.3	11.6	4.6	7.7	11.0	9.3
41.2	13.8	11.5	4.5	7.6	9.0	9.2
44.7	10.3	9.7	5.2	11.5	8.0	8.6
47.4	7.6	7.6	6.1	9.7	7.0	7.8
50.0	5.0	5.0	7.8	7.6	5.0	6.4
45.0	10.0	10.0	7.3	1.0	6.0	6.2
45.0	10.0	10.0	7.4	6.0	6.0	6.1
45.0	10.0	10.0	6.4	8.0	8.0	7.0
50.0	5.0	5.0	9.1	9.0	4.0	5.5
42.0	13.0	8.5	5.4	2.0	10.0	7.8

QS	QR	X	P	Y	Z	CP
42.5	12.5	8.7	5.4	8.5	8.0	7.9
39.2	15.8	13.3	3.9	8.7	12.0	9.9
48.5	6.5	6.5	7.0	13.3	4.0	7.0
43.0	12.0	10.8	4.8	5.5	11.0	9.0
44.8	10.2	9.5	5.3	9.8	8.0	8.5
48.3	6.7	6.7	6.7	9.5	6.0	7.2
48.0	7.0	7.0	7.2	5.7	6.0	6.6
47.0	8.0	8.0	6.4	7.0	8.0	7.3
46.0	9.0	9.0	7.5	4.0	5.0	6.2
47.0	8.0	8.0	7.1	8.0	7.0	6.6
47.0	8.0	8.0	6.4	8.0	8.0	7.3
39.0	16.0	11.8	4.3	3.0	11.0	9.1
37.8	17.2	13.8	3.8	9.8	11.0	10.1
41.6	13.4	10.1	4.9	10.3	7.0	8.5
46.3	8.2	8.2	6.9	10.1	5.0	6.8
48.0	7.0	7.0	8.2	6.2	5.0	5.9
49.0	6.0	6.0	8.2	7.0	6.0	5.9
41.0	14.0	10.1	4.8	3.0	11.0	8.5
43.1	11.9	8.3	5.6	9.1	7.0	7.7
43.4	11.6	10.7	8.1	3.3	3.0	5.4
48.1	6.9	6.9	11.5	7.7	3.0	4.2
42.0	13.0	12.2	6.9	1.9	8.0	6.1
47.2	7.8	7.8	7.8	11.2	6.0	6.0
49.0	6.0	6.0	8.1	7.8	6.0	6.0
50.0	5.0	5.0	9.1	6.0	5.0	5.5
47.0	8.0	8.0	8.9	2.0	5.0	5.3
51.0	4.0	4.0	11.0	8.0	4.0	4.6
47.0	8.0	8.0	7.4	4.0	8.0	6.3
42.0	13.0	12.3	4.3	8.0	13.0	9.7
47.3	7.7	7.7	5.7	12.3	7.0	8.3
48.0	7.0	7.0	6.3	7.7	7.0	7.7
46.0	9.0	9.0	5.5	7.0	9.0	8.3
46.0	9.0	9.0	5.3	9.0	9.0	8.7
41.0	14.0	12.8	4.2	6.0	11.0	9.8
44.8	10.2	9.4	5.3	10.8	7.0	8.4
46.2	8.8	8.7	5.6	9.4	8.0	8.2
37.9	17.1	14.9	3.6	4.7	13.0	10.6
47.8	7.2	7.2	6.1	14.9	5.0	7.8
43.0	12.0	12.0	4.3	7.2	12.0	9.9
44.0	11.0	11.0	4.2	12.0	11.0	10.5
45.0	10.0	10.0	4.9	9.0	8.0	9.2
46.0	9.0	9.0	5.3	9.0	3.0	8.6
38.0	17.0	12.3	4.1	2.0	10.0	9.3
44.3	10.7	7.9	5.8	12.3	6.0	7.7
43.2	11.8	9.5	5.2	7.9	9.0	8.3
43.7	11.3	11.3	6.1	6.5	6.0	7.2
39.0	16.0	14.7	3.7	9.3	14.0	10.6
38.7	16.3	16.1	3.4	11.7	12.0	11.3

QS	QR	X	P	Y	Z	CP
47.8	7.2	7.2	5.2	16.1	7.0	9.1
41.0	14.0	9.3	5.1	0.2	7.0	8.1
41.3	13.7	10.2	4.8	9.3	9.0	8.5
40.5	14.5	12.8	4.1	10.2	11.0	9.8
43.3	11.7	11.6	4.6	11.8	9.0	9.4
49.8	5.2	5.2	6.9	11.6	5.0	7.2
45.0	10.0	8.7	5.6	4.2	9.0	8.1
38.7	16.3	14.6	3.7	6.7	13.0	10.5
48.3	6.7	6.7	6.2	14.6	5.0	7.8
47.0	8.0	7.9	6.0	6.7	8.0	7.9
42.9	12.1	7.7	5.3	2.9	7.0	7.4
41.7	13.3	9.5	5.1	7.7	9.0	8.2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QR=5.
CP=5.
ALPHA=.5
QLAMDA=8.
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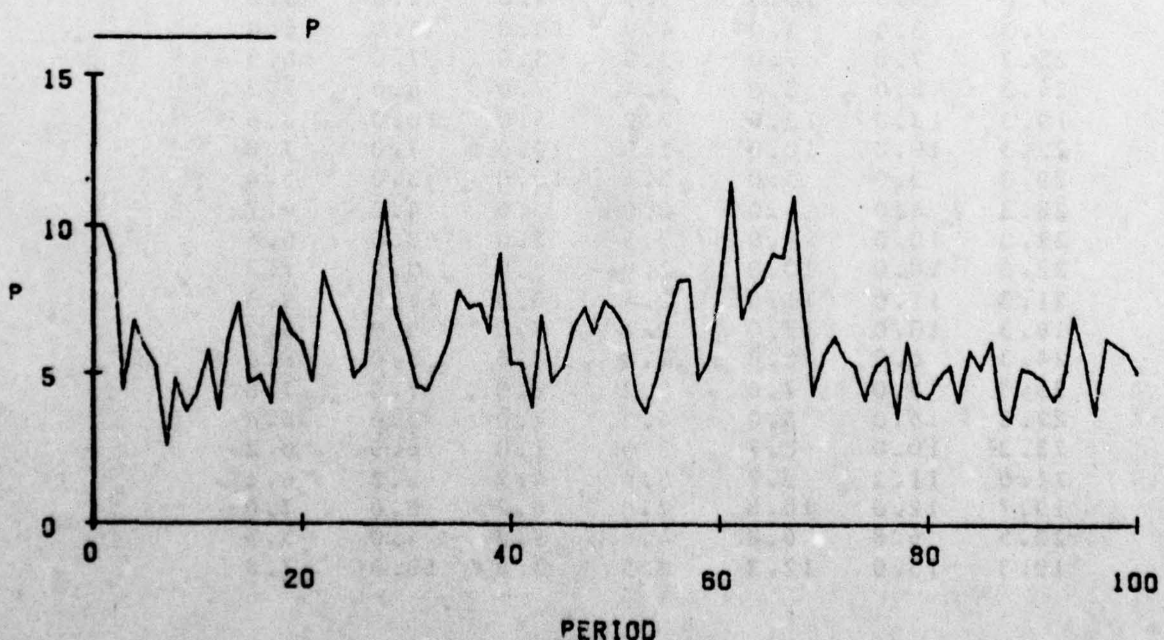
40
60
80
100
PERIOD


P
0
5
10
15
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

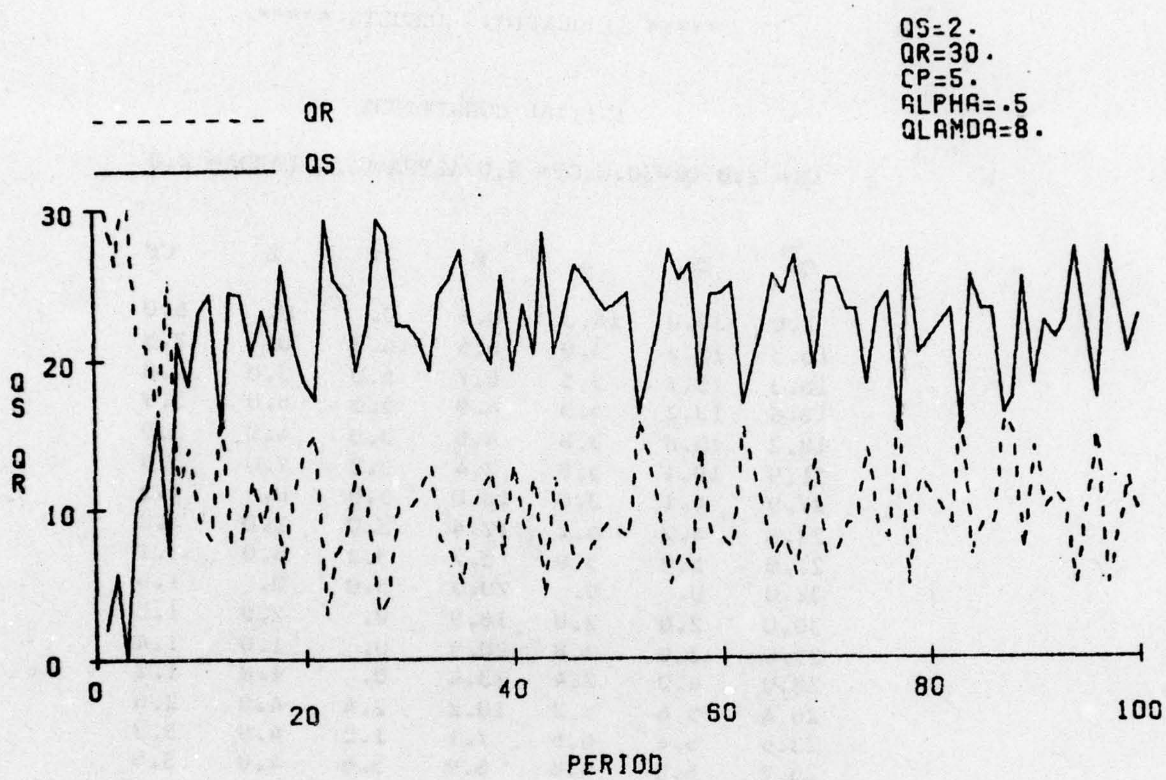
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.50 LAMDA= 8.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	9.7	0.4	0.	0.	5.0
5.7	26.3	10.1	1.0	9.7	6.0	5.5
0.	32.3	17.5	0.	6.1	12.0	8.8
10.5	21.8	11.0	1.6	14.5	4.0	6.4
11.5	20.8	13.5	1.5	10.0	9.0	7.7
16.0	16.3	14.0	1.9	13.5	9.0	8.3
7.0	25.3	22.2	0.6	6.0	15.0	11.7
21.2	11.1	11.1	2.5	19.2	5.0	8.3
18.3	14.0	14.0	1.9	8.1	11.0	9.7
23.3	9.0	9.0	2.5	14.0	9.0	9.3
24.3	8.0	8.0	3.2	7.0	6.0	7.7
15.3	17.0	16.1	1.6	2.0	11.0	9.3
24.4	7.9	7.9	3.7	13.1	4.0	6.7
24.3	8.0	8.0	3.8	5.9	6.0	6.3
20.3	12.0	12.0	2.2	8.0	12.0	9.2
23.3	9.0	9.0	2.6	12.0	9.0	9.1
20.3	12.0	12.0	1.9	9.0	12.0	10.5
26.3	6.0	6.0	3.9	9.0	3.0	6.3
21.3	11.0	10.2	3.1	2.0	7.0	6.9
18.5	13.8	10.8	2.7	4.2	7.0	6.9
17.3	15.0	15.0	1.9	9.8	11.0	9.0
29.3	3.0	3.0	4.9	15.0	3.0	6.0
25.3	7.0	7.0	3.9	3.0	7.0	6.5
24.3	8.0	8.0	3.4	7.0	8.0	7.2
19.3	13.0	13.0	2.2	5.0	10.0	8.6
22.3	10.0	10.0	2.9	10.0	7.0	7.8
29.3	3.0	3.0	5.4	10.0	3.0	5.4
28.3	4.0	4.0	6.0	3.0	4.0	4.7
22.3	10.0	9.0	3.5	2.0	8.0	6.4
22.3	10.0	10.0	2.9	9.0	9.0	7.7
21.3	11.0	11.0	2.3	10.0	11.0	9.3
19.3	13.0	13.0	2.1	7.0	9.0	9.2
24.3	8.0	8.0	2.8	13.0	8.0	8.6
25.3	7.0	7.0	3.2	8.0	7.0	7.8
27.3	5.0	5.0	4.3	7.0	5.0	6.4
22.3	10.0	8.7	3.6	1.0	6.0	6.2
21.0	11.3	8.7	3.4	4.7	6.0	6.1
19.7	12.6	10.8	2.8	6.7	8.0	7.0
25.5	6.8	6.8	4.6	9.8	4.0	5.5
19.3	13.0	12.3	2.5	3.8	10.0	7.8

QS	QR	X	P	Y	Z	CP
23.6	8.7	8.7	3.0	12.3	8.0	7.9
20.3	12.0	12.0	2.0	8.7	12.0	9.9
23.3	4.0	4.0	4.1	12.0	4.0	7.0
20.3	12.0	12.0	2.3	3.0	11.0	9.0
23.3	9.0	9.0	2.7	11.0	8.0	8.5
26.3	6.0	6.0	3.6	9.0	6.0	7.2
25.3	7.0	7.0	3.8	5.0	6.0	6.6
24.3	8.0	8.0	3.3	7.0	8.0	7.3
23.3	9.0	8.4	3.8	4.0	5.0	6.2
23.7	8.6	8.6	3.6	7.4	7.0	6.6
24.3	8.0	8.0	3.3	8.6	8.0	7.3
16.3	16.0	15.6	1.8	3.0	11.0	9.1
18.9	13.4	13.4	1.9	13.6	11.0	10.1
22.3	10.0	10.0	2.6	10.4	7.0	8.5
27.3	5.0	5.0	4.0	10.0	5.0	6.8
25.3	7.0	7.0	4.3	3.0	5.0	5.9
26.3	[illegible]	6.0	4.4	7.0	6.0	5.9
18.3	14.0	13.9	2.2	3.0	11.0	8.5
24.2	8.1	8.1	3.1	12.9	7.0	7.7
24.3	8.0	6.7	4.5	3.1	3.0	5.4
25.0	7.3	4.2	6.0	3.7	3.0	4.2
17.0	15.3	9.4	2.8	0.	8.0	6.1
19.3	13.0	8.9	3.2	8.4	6.0	6.0
22.2	10.1	8.3	3.7	8.9	6.0	6.0
25.5	6.7	6.7	4.6	8.3	5.0	5.5
24.3	8.0	6.5	4.6	3.7	5.0	5.3
26.7	5.5	4.8	5.8	6.5	4.0	4.6
23.5	8.7	8.7	3.7	4.8	8.0	6.3
19.2	13.0	13.0	2.0	8.7	13.0	9.7
25.3	7.0	7.0	3.0	13.0	7.0	8.3
25.3	7.0	7.0	3.3	7.0	7.0	7.7
23.3	9.0	9.0	2.8	7.0	9.0	8.3
23.3	9.0	9.0	2.7	9.0	9.0	8.7
18.3	14.0	14.0	1.9	6.0	11.0	9.8
23.3	9.0	9.0	2.8	12.0	7.0	8.4
24.3	8.0	8.0	3.0	9.0	8.0	8.2
15.3	17.0	17.0	1.4	4.0	13.0	10.6
27.3	5.0	5.0	3.5	17.0	5.0	7.8
20.3	12.0	12.0	2.0	5.0	12.0	9.9
21.3	11.0	11.0	2.0	12.0	11.0	10.5
22.3	10.0	10.0	2.4	9.0	8.0	9.2
23.3	9.0	9.0	2.7	9.0	8.0	8.6
15.3	17.0	16.1	1.6	2.0	10.0	9.3
25.3	6.9	6.9	3.3	16.1	6.0	7.7
23.3	9.0	9.0	2.8	6.9	9.0	8.3
23.3	9.0	9.0	3.2	6.0	6.0	7.2
16.3	16.0	16.0	1.5	7.0	14.0	10.6
17.3	15.0	15.0	1.5	13.0	12.0	11.3

QS	QR	X	P	Y	Z	CP
25.3	7.0	7.0	2.8	15.0	7.0	9.1
18.3	14.0	13.1	2.3	0.	7.0	8.1
22.4	9.9	9.9	2.6	13.1	9.0	8.5
21.3	11.0	11.0	2.2	9.9	11.0	9.8
22.3	10.0	10.0	2.4	10.0	9.0	9.4
27.3	5.0	5.0	3.8	10.0	5.0	7.2
22.3	10.0	10.0	2.8	4.0	9.0	8.1
17.3	15.0	15.0	1.6	8.0	13.0	10.5
27.3	5.0	5.0	3.5	15.0	5.0	7.8
24.3	8.0	8.0	3.1	5.0	8.0	7.9
20.3	12.0	11.5	2.7	3.0	7.0	7.4
22.8	9.5	9.5	2.8	11.5	9.0	8.2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Q
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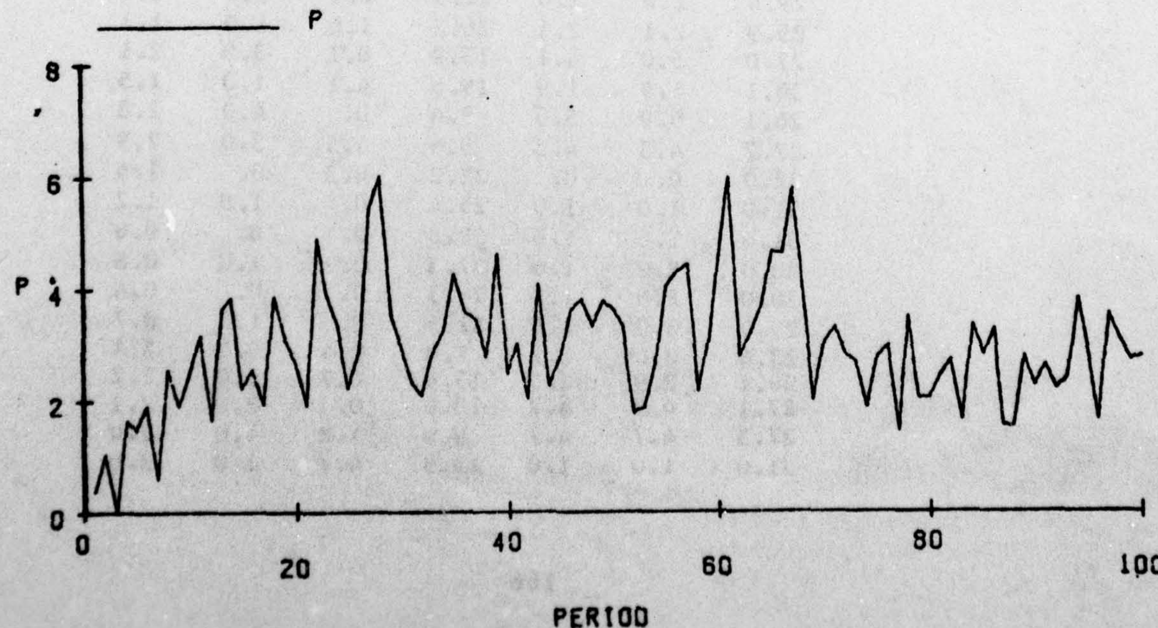
60
80
100
PERIOD


P
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6
4
2
0
P
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

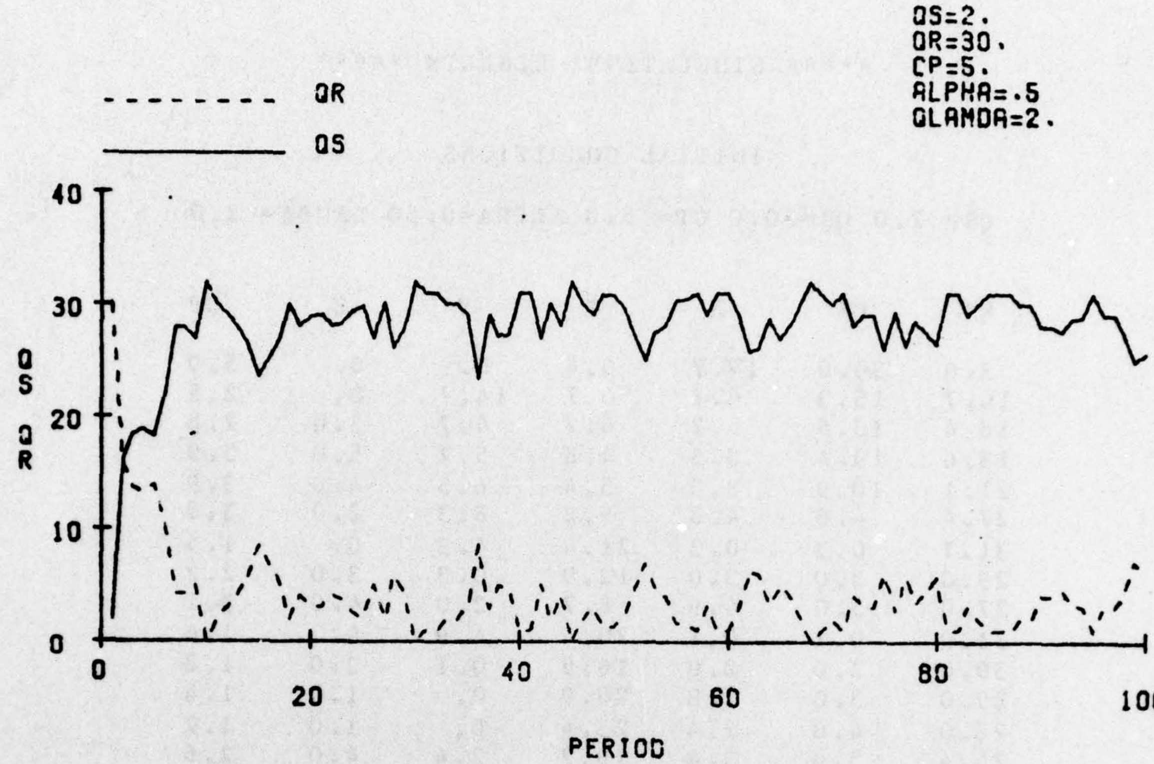
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.50 LAMDA= 2.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	14.3	0.4	0.	0.	5.0
16.3	15.7	5.0	6.5	14.3	0.	2.5
18.3	13.7	5.5	6.7	5.0	3.0	2.8
18.8	13.2	5.3	4.9	5.5	5.0	3.9
18.2	13.8	5.8	4.6	3.3	4.0	3.9
21.9	10.1	5.9	7.4	5.8	2.0	3.0
27.9	4.1	3.0	18.8	5.9	0.	1.5
27.8	4.2	4.2	12.4	3.0	3.0	2.2
27.0	5.0	5.0	8.7	3.2	4.0	3.1
32.0	0.	0.	20.5	5.0	0.	1.6
30.0	2.0	2.0	16.9	0.	2.0	1.8
29.0	3.0	2.8	20.9	0.	1.0	1.4
28.0	4.0	2.4	23.4	0.	1.0	1.2
26.4	5.6	5.2	10.2	2.4	4.0	2.6
23.6	8.4	6.6	7.1	1.2	4.0	3.3
25.2	6.8	6.8	6.9	5.6	4.0	3.6
27.0	5.0	5.0	9.6	3.8	2.0	2.8
30.0	2.0	2.0	15.7	4.0	1.0	1.9
28.0	4.0	3.9	14.3	0.	2.0	2.0
28.9	3.1	3.1	11.7	3.9	3.0	2.5
29.0	3.0	2.5	23.4	0.1	0.	1.2
28.0	4.0	2.2	25.0	0.	1.0	1.1
28.2	3.8	3.1	18.1	2.2	2.0	1.6
29.4	2.6	2.6	22.9	2.1	1.0	1.3
29.9	2.1	2.1	26.2	1.6	1.0	1.1
27.0	5.0	4.1	13.0	0.1	3.0	2.1
30.1	1.9	1.9	19.6	4.1	1.0	1.5
26.1	5.9	5.5	9.4	0.	4.0	2.8
27.7	4.3	4.3	9.6	4.5	3.0	2.9
32.0	0.	0.	22.2	4.3	0.	1.4
31.0	1.0	1.0	25.4	0.	1.0	1.2
31.0	1.0	1.0	50.8	0.	0.	0.6
30.0	2.0	1.6	37.3	0.	1.0	0.8
30.0	2.0	1.0	74.5	0.	0.	0.4
29.0	3.0	1.4	41.4	0.	1.0	0.7
23.4	8.6	6.7	7.0	0.4	6.0	3.4
29.1	2.9	2.9	13.4	6.7	1.0	2.2
27.1	4.9	4.2	13.0	0.	2.0	2.1
27.3	4.7	4.7	9.0	4.2	4.0	3.0
31.0	1.0	1.0	15.3	4.7	1.0	2.0

QS	QR	X	P	Y	Z	CP
31.0	1.0	1.0	20.5	1.0	1.0	1.5
27.0	5.0	5.0	9.8	0.	4.0	2.8
30.0	2.0	2.0	16.0	4.0	1.0	1.9
28.0	4.0	4.0	9.5	2.0	4.0	2.9
32.0	0.	0.	21.8	4.0	0.	1.5
30.0	2.0	2.0	17.3	0.	2.0	1.7
29.0	3.0	2.7	21.2	0.	1.0	1.4
30.7	1.3	1.3	26.0	2.7	1.0	1.2
30.7	1.3	1.2	51.9	0.	0.	0.6
29.7	2.3	1.6	37.4	0.	1.0	0.8
27.3	4.7	4.7	11.4	1.6	4.0	2.4
25.0	7.0	5.4	9.3	0.7	3.0	2.7
27.4	4.6	4.6	11.7	4.4	2.0	2.3
28.0	4.0	2.3	23.8	0.6	0.	1.2
30.3	1.7	1.2	51.7	2.3	0.	0.6
30.5	1.5	1.5	38.5	1.2	1.0	0.8
31.0	1.0	1.0	34.6	1.5	1.0	0.9
29.0	3.0	3.0	14.9	1.0	3.0	1.9
31.0	1.0	1.0	21.0	3.0	1.0	1.5
31.0	1.0	1.0	42.1	0.	0.	0.7
29.0	3.0	2.7	21.2	0.	2.0	1.4
25.7	6.3	5.4	9.6	0.7	4.0	2.7
26.1	5.9	4.7	11.1	2.4	2.0	2.3
28.8	3.2	3.2	13.3	4.7	2.0	2.2
27.0	5.0	4.2	12.9	0.2	2.0	2.1
28.2	3.8	3.1	18.3	2.2	1.0	1.5
30.3	1.7	1.7	23.8	3.1	1.0	1.3
32.0	0.	0.	50.3	1.7	0.	0.6
31.0	1.0	1.0	37.9	0.	1.0	0.8
30.0	2.0	2.0	21.3	1.0	2.0	1.4
31.0	1.0	1.0	25.7	2.0	1.0	1.2
28.0	4.0	4.0	13.3	0.	3.0	2.1
29.0	3.0	3.0	18.7	2.0	1.0	1.6
29.0	3.0	3.0	12.7	3.0	3.0	2.3
26.0	6.0	5.3	9.9	0.	3.0	2.6
29.3	2.7	2.7	12.6	5.3	2.0	2.3
26.3	5.7	5.3	9.9	0.	3.0	2.7
28.6	3.4	3.4	10.1	5.3	3.0	2.8
27.6	4.4	3.8	14.4	0.	1.0	1.9
26.4	5.6	5.6	7.6	3.8	5.0	3.5
31.0	1.0	1.0	13.9	5.6	1.0	2.2
31.0	1.0	1.0	27.8	0.	0.	1.1
29.0	3.0	3.0	18.6	0.	2.0	1.6
30.0	2.0	2.0	23.5	2.0	1.0	1.3
31.0	1.0	1.0	27.2	2.0	1.0	1.1
31.0	1.0	1.0	29.0	1.0	1.0	1.1
31.0	1.0	1.0	30.0	1.0	1.0	1.0
30.0	2.0	2.0	29.5	0.	1.0	1.0

QS	QR	X	P	Y	Z	CP
30.0	2.0	2.0	29.7	1.0	1.0	1.0
28.0	4.0	3.0	18.6	0.	2.0	1.5
28.0	4.0	2.5	22.4	1.0	1.0	1.3
27.5	4.5	4.3	12.9	2.5	3.0	2.1
28.8	3.2	2.1	27.1	1.3	0.	1.1
28.9	3.1	3.1	18.9	2.1	2.0	1.5
31.0	1.0	1.0	24.5	3.1	1.0	1.3
29.0	3.0	3.0	17.7	0.	2.0.	1.6
29.0	3.0	2.6	22.0	1.0	1.0	1.3
27.6	4.4	3.3	16.7	0.6	2.0	1.7
24.9	7.1	4.7	10.7	0.3	3.0	2.3
25.6	6.4	4.3	11.8	2.7	2.0	2.2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ALPHA=.5
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R
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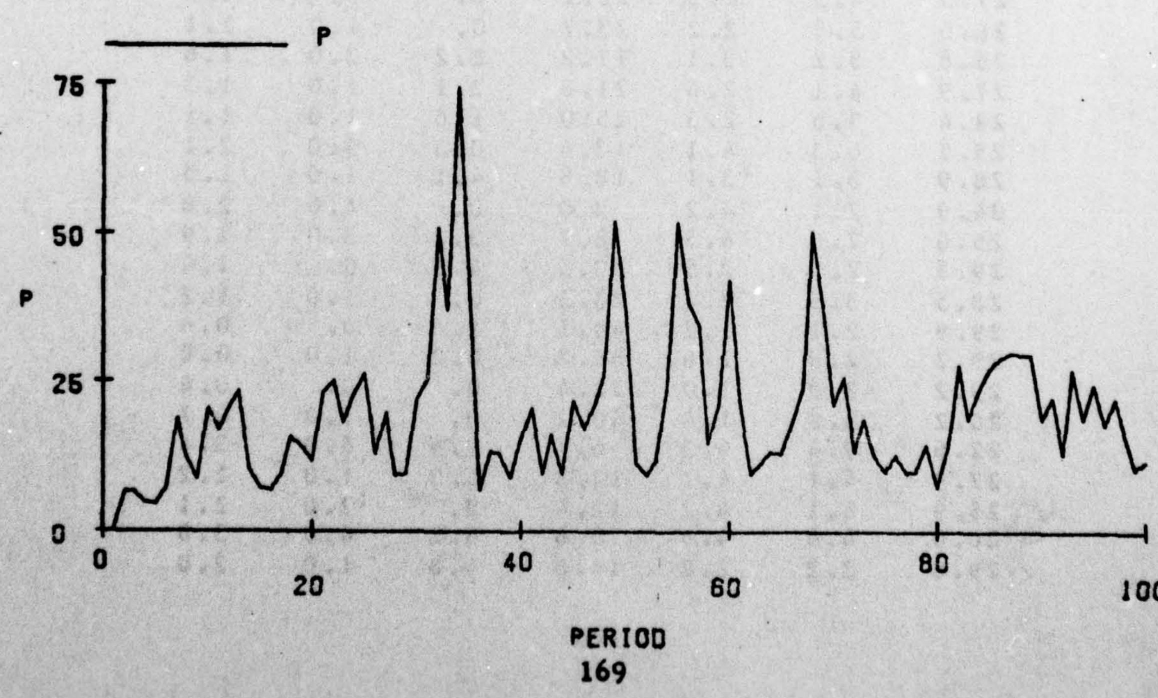
40
60
80
100
PERIOD


P
75
50
25
0
P
0
20
40
60
80
100
PERIOD

***** SIMULATION RESULTS *****

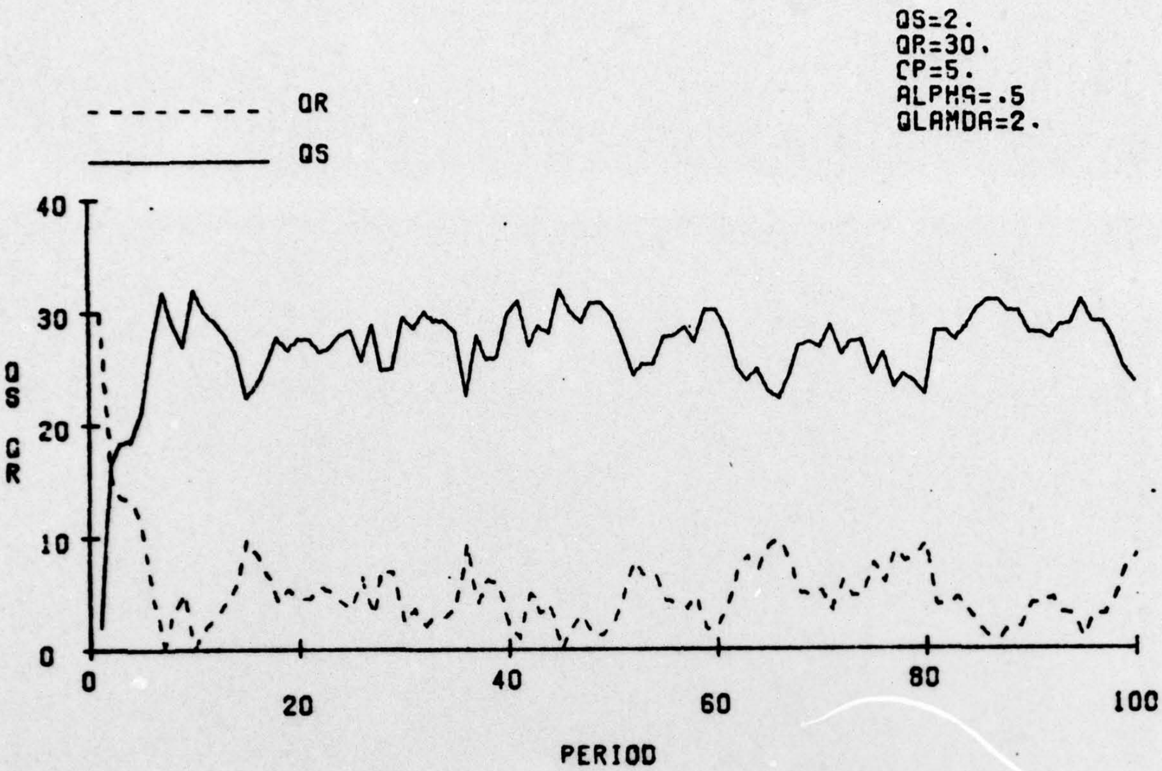
INITIAL CONDITIONS

QS= 2.0 QR=30.0 CP= 5.0 ALPHA=0.50 LAMDA= 2.0

QS	QR	X	P	Y	Z	CP
2.0	30.0	14.7	0.4	0.	0.	5.0
16.7	15.3	4.7	6.7	14.7	0.	2.5
18.4	13.6	5.2	6.7	4.7	3.0	2.8
18.6	13.4	8.5	4.8	5.2	5.0	3.9
21.1	10.9	8.3	5.4	6.5	4.0	3.9
27.4	4.6	4.3	9.2	8.3	2.0	3.0
31.7	0.3	0.3	21.4	4.3	0.	1.5
29.0	3.0	3.0	12.9	0.3	3.0	2.2
27.0	5.0	4.9	8.7	2.0	4.0	3.1
31.9	0.1	0.1	20.4	4.9	0.	1.6
30.0	2.0	2.0	16.9	0.1	2.0	1.8
29.0	3.0	2.8	20.9	0.	1.0	1.4
28.0	4.0	2.4	23.4	0.	1.0	1.2
26.4	5.6	3.4	10.2	2.4	4.0	2.6
22.4	9.6	6.2	6.8	0.	4.0	3.3
23.6	8.4	7.0	6.5	5.2	4.0	3.6
25.6	6.4	4.2	9.1	4.0	2.0	2.8
27.8	4.2	3.8	14.5	3.2	1.0	1.9
26.6	5.4	3.9	13.6	0.8	2.0	2.0
27.5	4.5	2.8	11.1	3.9	3.0	2.5
27.5	4.5	2.5	22.2	0.	0.	1.2
26.5	5.5	2.2	23.7	0.	1.0	1.1
26.8	5.2	3.1	17.2	2.2	2.0	1.6
27.9	4.1	2.6	21.8	2.1	1.0	1.3
28.4	3.6	2.3	25.0	1.6	1.0	1.1
25.7	6.3	4.1	12.4	0.3	3.0	2.1
28.9	3.1	3.1	18.8	4.1	1.0	1.5
24.9	7.1	4.2	9.0	0.	4.0	2.8
25.0	7.0	4.5	8.7	3.2	3.0	2.9
29.5	2.5	2.5	20.5	4.5	0.	1.4
28.5	3.5	2.4	23.3	0.	1.0	1.2
29.9	2.1	1.2	49.1	1.4	0.	0.6
29.2	2.8	1.6	36.2	0.2	1.0	0.8
29.2	2.8	1.0	72.4	0.	0.	0.4
28.2	3.8	1.4	40.2	0.	1.0	0.7
22.6	9.4	6.3	6.7	0.4	6.0	3.4
27.9	4.1	4.1	12.8	6.3	1.0	2.2
25.9	6.1	4.2	12.4	0.	2.0	2.1
26.0	6.0	4.8	8.6	4.2	4.0	3.0
29.8	2.2	2.2	14.8	4.8	1.0	2.0

QS	QR	X	P	Y	Z	CP
31.0	1.0	1.0	20.5	2.2	1.0	1.5
27.0	5.0	3.8	9.8	0.	4.0	2.8
28.8	3.2	3.2	15.3	2.8	1.0	1.9
28.0	4.0	4.0	9.5	3.2	4.0	2.9
32.0	0.	0.	21.8	4.0	0.	1.5
30.0	2.0	2.0	17.3	0.	2.0	1.7
29.0	3.0	2.7	21.2	0.	1.0	1.4
30.7	1.3	1.3	26.0	2.7	1.0	1.2
30.7	1.3	1.2	51.9	0.	0.	0.6
29.7	2.3	1.6	37.4	0.	1.0	0.8
27.3	4.7	2.6	11.4	1.6	4.0	2.4
24.3	7.7	4.0	9.0	0.	3.0	2.7
25.4	6.6	2.8	10.8	3.0	2.0	2.3
25.4	6.6	2.3	21.6	0.	0.	1.2
27.7	4.3	1.2	47.2	2.3	0.	0.6
27.9	4.1	1.6	35.1	1.2	1.0	0.8
28.5	3.5	1.8	31.3	1.6	1.0	0.9
27.3	4.7	3.9	14.0	1.8	3.0	1.9
30.2	1.8	1.8	20.5	3.9	1.0	1.5
30.2	1.8	1.5	40.9	0.	0.	0.7
28.2	3.8	2.7	20.6	0.	2.0	1.4
24.9	7.1	3.9	9.3	0.7	4.0	2.7
23.8	8.2	3.1	10.2	0.9	2.0	2.3
24.9	7.1	2.4	11.5	3.1	2.0	2.2
22.9	9.1	2.4	11.0	0.	2.0	2.1
22.3	9.7	3.1	14.5	0.4	1.0	1.5
24.4	7.6	2.5	19.2	3.1	1.0	1.3
26.9	5.1	1.3	42.4	2.5	0.	0.6
27.2	4.8	1.6	33.3	1.3	1.0	0.8
26.8	5.2	2.8	19.1	1.6	2.0	1.4
28.7	3.3	2.4	23.8	2.8	1.0	1.2
26.1	5.9	4.2	12.4	0.4	3.0	2.1
27.3	4.7	3.1	17.6	2.2	1.0	1.6
27.4	4.6	4.6	12.0	3.1	3.0	2.3
24.4	7.6	3.8	9.2	0.	3.0	2.6
26.2	5.8	2.6	11.3	3.8	2.0	2.3
23.2	8.8	4.1	8.7	0.	3.0	2.7
24.3	7.7	4.4	8.6	4.1	3.0	2.8
23.8	8.2	3.8	12.4	0.4	1.0	1.9
22.6	9.4	6.6	6.5	3.8	5.0	3.5
28.2	3.8	3.8	12.7	6.6	1.0	2.2
28.2	3.8	2.2	25.3	0.	0.	1.1
27.4	4.6	3.1	17.6	1.2	2.0	1.6
28.5	3.5	2.6	22.3	2.1	1.0	1.3
30.1	1.9	1.9	26.4	2.6	1.0	1.1
31.0	1.0	1.0	29.0	1.9	1.0	1.1
31.0	1.0	1.0	30.0	1.0	1.0	1.0
30.0	2.0	2.0	29.5	0.	1.0	1.0

QS	QR	X	P	Y	Z	CP
30.0	2.0	2.0	29.7	1.0	1.0	1.0
28.0	4.0	3.0	18.6	0.	2.0	1.5
28.0	4.0	2.5	22.4	1.0	1.0	1.3
27.5	4.5	4.3	12.9	2.5	3.0	2.1
28.8	3.2	2.1	27.1	1.3	0.	1.1
28.9	3.1	3.1	13.9	2.1	2.0	1.5
31.0	1.0	1.0	24.5	3.1	1.0	1.3
29.0	3.0	3.0	17.7	0.	2.0	1.6
29.0	3.0	2.6	22.0	1.0	1.0	1.3
27.6	4.4	3.3	16.7	0.6	2.0	1.7
24.9	7.1	2.8	10.7	0.3	3.0	2.3
23.8	8.2	2.5	11.0	0.8	2.0	2.2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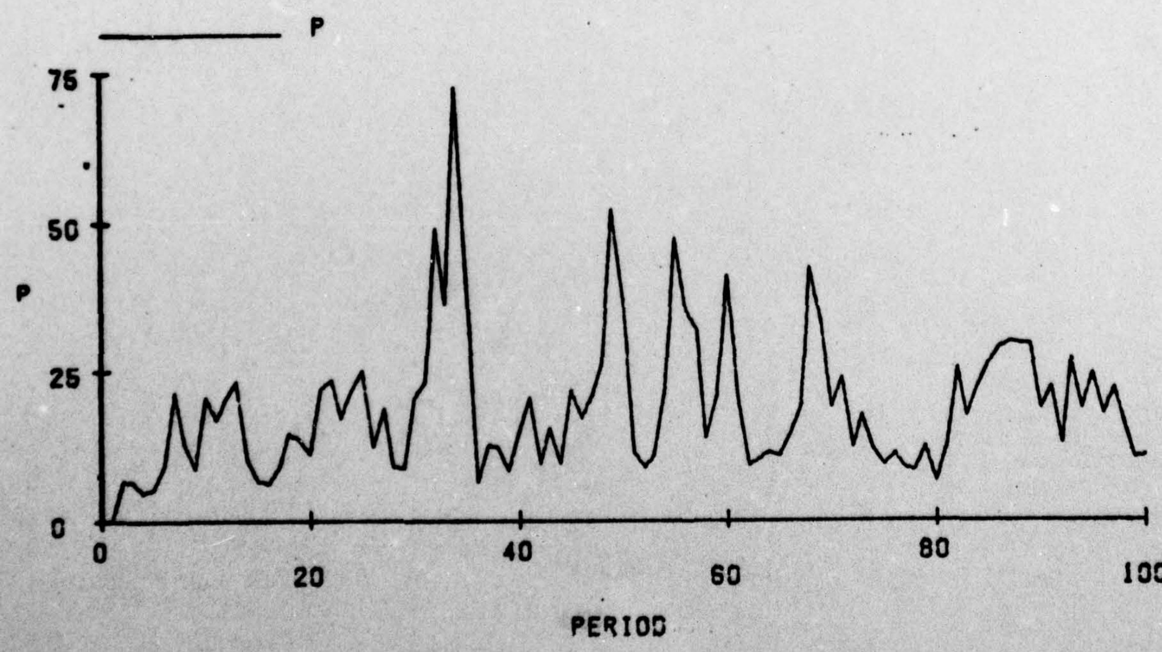
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